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# Perceptions Measurement of Professional Certifications to Augment Buffalo State College Baccalaureate Technology Programs, as a Representative American Postsecondary Educational Institution

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State University of New York  
College at Buffalo  
Department of Technology

**Perceptions Measurement of Professional Certifications to Augment Buffalo State  
College Baccalaureate Technology Programs, as a Representative American  
Postsecondary Educational Institution**

A Thesis in  
Industrial Technology

by

Christopher Nicholas Brown

Submitted in Partial Fulfillment  
of the Requirements  
for the Degree of

Master of Science  
May, 2012

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### **Abstract of Thesis**

The purpose of this study was to assess, measure, and analyze whether voluntary, nationally-recognized professional certification credentials were important to augment technology programs at Buffalo State College (BSC), as a representative postsecondary baccalaureate degree-granting institution offering technology curricula. Six BSC undergraduate technology programs were evaluated within the scope of this study: 1.) Computer Information Systems; 2.) Electrical Engineering, Electronics; 3.) Electrical Engineering, Smart Grid; 4.) Industrial Technology; 5.) Mechanical Engineering; and 6.) Technology Education. This study considered the following three aspects of the problem: a.) postsecondary technology program enrollment and graduation trends; b.) the value/awareness of professional certifications to employers and students; and c.) professional certification relevancy and postsecondary curricula integration. The study was conducted through surveys and interviews with four technology-related purposive sample groups: 1.) BSC program alumni; 2.) BSC and non-BSC technology program faculty; 3.) hiring managers/industry leaders; and 4.) non-BSC alumni and certification holders. In addition, this study included an analysis of relevant professional certification organizations and student enrollment data from the six technology programs within scope. Research methods included both quantitative and qualitative analytical techniques. This study concluded undergraduate technology students benefitted from a greater awareness of relevant professional certifications and their perceived value. This study also found the academic community may be well served to acknowledge the increasing trend of professional certification integration into postsecondary technology programs.

Christopher Nicholas Brown

April 19, 2012

PROF. CERTIFICATIONS AUGMENTATION OF BSC TECH PROGRAMS

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# PROF. CERTIFICATIONS AUGMENTATION OF BSC TECH PROGRAMS

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### Acknowledgements

The idea for this study was inspired by my experience as an information technology infrastructure manager. After having lived through the beginning of the microcomputer industry and the origin of computer technology certifications, I experienced their impact first hand. Having had the experience of hiring dozens of employees and contractors, I am required to be aware of the value of certifications and their significance, especially the effort required for their achievement. Despite the certification craze during the now infamous Y2K-era, a decade later certifications remain relevant and, according to many, are more so than ever before. While certifications impacted postsecondary educational programs, I am aware they are not universally embraced. During the course of this study's research, I became more acutely aware of the certifications technology professionals chose to pursue. Recently, I received a business card from an information technology professional. On his card was printed the infamous *alphabet soup* of certification initials following his name, typically used to connote knowledge, experience, and significance. One certification was unknown to me and therefore piqued my interest. Upon researching the particular initialism, I learned it was a certification for scuba diving! While the knowledge gained for the certification may be important when literally under water, I couldn't help but feel it was misleading in a technology context. It reinforced my understanding of why professional certifications are sometimes viewed with disdain.

In my profession, certification credentials such as those offered by Cisco, Microsoft, ITIL, and ISC<sup>2</sup> remain important. Some of my peers and senior technology management endorse certifications to a great extent. They not only pursue them for

themselves, but have become instructors. They teach certification classes to co-workers and other students, including those enrolled in community college technology programs. As I began the process to select a suitable topic for a thesis for my graduate program at Buffalo State College, I was intrigued by the maturity and sophistication of the Cisco CCNA course curriculum that made use of traditional instructors, textbooks, and augmented by on-demand computer-based instruction. It rivaled, and was perhaps superior to, the format of any undergraduate class I attended.

It was also important to me to select a thesis topic that was meaningful locally. If certification programs had proliferated to such an extent exhibited within computer technology, similar certification programs might be applicable to the other technology programs at Buffalo State College and therefore relevant to other postsecondary technology programs throughout the nation. As I began my research, I learned there were few studies on this topic, and therefore believed it would make an ideal study. I hope the reader may find some of the results worthy of the effort.

Because a large part of this study was dependent upon the identification of technical certifications to their associated technology programs within the scope of this study, I believed it was important to firmly establish the capacity and origin of the six programs included within the scope of this study so appropriate certifications could be thus correlated. The basis for the establishment of the Buffalo State College technology programs is contained primarily in Chapter Two (although there are references to it in all the remaining chapters as well). Although I intended this portion of the thesis to be relatively brief, I was drawn to it, and returned to it again and again. As an experienced architectural history and genealogical researcher for various publications and nonprofit

organizations, I was frustrated by the lack of published information and more importantly, the inaccuracies contained in the small amount of material that had been published. Consequently, I believed I could add clarity to this research. As a result, Chapter Two is far longer than I originally anticipated, yet I hope it yields value for present readers and future researchers.

I would like to thank all those who spent their time being interviewed and who responded to surveys and questionnaires. Many individuals graciously donated their time and talent to this study and I was never ceased to be amazed at the level to which others were willing to assist me in this research. I would also like to thank the members of my thesis committee: my advisor, Dr. Earshen for his wisdom, direction, and support with this study as well as Dr. Steve Macho, whose thorough and thoughtful review of the thesis has led to a greatly improved study.

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## **Chapter One: Introduction**

On February 24, 2009 President Obama, during an address made to the Joint Session of Congress, issued a plea to his fellow citizens:

I ask every American to commit to at least one year or more of higher education or career training. This can be a community college or a four-year school; vocational training or an apprenticeship. But whatever the training may be, every American will need to get more than a high school diploma (Obama, *We Can Work Together to Overcome*, 2009, p. 150).

Two years later, in March 2011, a report issued by the Skills2Compete-New York Campaign/National Skills Coalition refined the President's plea for New York State residents:

In partnership with a broad coalition of business, labor and education leaders, the Skills2Compete-New York Campaign is calling on state leaders to embrace a strong vision to guide an economic and education strategy that would allow residents to meet or exceed the President's challenge: every New York resident should have access to the equivalent of at least two years of education or training past high school—leading to a vocational credential, industry certification, or one's first two years of college—to be pursued at whatever point and pace makes sense for individual workers and industries (Wilczynski, 2011, p. 5).

Georgetown University's Center on Education and the Workforce validated the significance of professional certifications and the significance of their federal funding when it reported: "The expanded federal postsecondary recognition of postsecondary certificates, industry-based certifications, and apprenticeships with labor market value voiced in the president's statements and made explicit in the American Graduation Initiative have greatly expanded the legitimate reach of postsecondary education and training" (Carnevale, *Postsecondary Education and Training As We Know It Is Not Enough*, 2010, p. 15).

Given the recent emphasis on industry or professional certifications, this study evaluates the impact of these credentials on postsecondary baccalaureate technology programs, limiting the scope of the study to six programs at Buffalo State College (as a representative example of a baccalaureate-granting public institution of higher learning). The study measures perceptions about technology enrollment/recruitment, the value/awareness of professional certifications, and the potential need for integration into postsecondary baccalaureate technology programs.

### **Buffalo State College**

Buffalo State College (BSC), also known as the State University College at Buffalo, is the State University of New York's (SUNY) largest four-year college. BSC first opened its doors in 1871 as the Buffalo Normal School and in 2012 is a diverse, urban college sited on a 125-acre campus serving over 11,000 students by offering 165 undergraduate programs and 62 graduate program options (BSC College Relations Office, 2011, p. 1).

Within its academic programs, Buffalo State College has a century-old tradition of quality technology programs. Not surprisingly, the evolution of technology education on a national level parallels changes at Buffalo State College, both as an institution and within its technology curricula. There are six current Buffalo State College undergraduate technology programs included within this study: 1.) computer information systems; 2.) electrical engineering, electronics; 3.) electrical engineering, smart grid; 4.) industrial technology; 5.) mechanical engineering; and 6.) technology education.

These programs attract several categories of students including traditional, nontraditional, and evening (commuter) students. While a baccalaureate degree has long



been the cornerstone of a traditional postsecondary education for professions, within the past two decades nationally-recognized professional, voluntary certifications with associated Internet-based program delivery have become increasingly popular.

Certifications associated with technology programs are especially popular since relatively short technology lifecycles require a lifelong continual education strategy of learning.

Thus, certifications provide a credential that demonstrates current mastery of a particular technology discipline or skill set.

### **National Perceptions**

Nationally, the varied and changing curricula of postsecondary baccalaureate technology programs are challenged on several fronts. These challenges include declining enrollment; loss of interest in industrial technology, computer science, and several other engineering fields; and increased competition for students through the growth of non-traditional Internet-based for-profit college institutions.

Due to a perception of the negative impact of outsourcing/off-shoring, globalization, and a shift in many manufacturing processes from the United States to Asia, there has been a national decline of college enrollment for the technology and engineering sectors (Ali & Shubra, 2010, p. 215). According to a 2012 report issued by the National Science Board, engineering accounts for four percent of the United States' Bachelor's degrees awarded in 2008. Of the five million university degrees awarded worldwide in 2008, U.S. students earned ten percent (National Science Board, 2012, pp. 2-5).

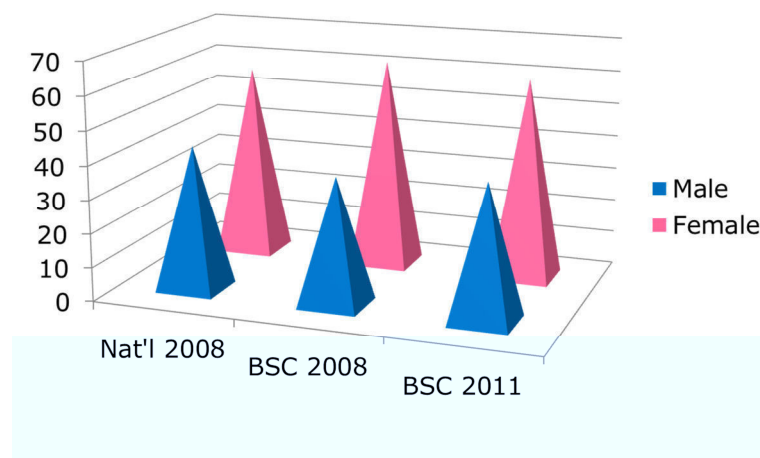
Enrollment in technology programs may also suffer from a perception that those who participate in those programs are maladjusted (Lenox, Woratschek, & Davis, 2008,

p. 3). Social perceptions that impact enrollment are important as they may override job placement opportunities. Ten-year employment projections indicate modest-to-accelerated gains in technology jobs through organic growth and retiring baby boomers (2011 a boom year for baby boomers, 2011). For example, the iconic image of a computer science major was for many years an anti-social geek (Hill, Corbett, & and St. Rose, 2010, pp. 60-61). A 1999 report by the U.S. Department of Commerce notes “many people have a distorted, negative image of Information Technology workers, scientists, and engineers, perceiving them as highly intelligent, but socially inept or absent-minded ‘geeks’ or ‘nerds’” (Meares & Sargent Jr., 1999, p. 56). When technically astute characters are portrayed on television or in motion pictures, they are usually played by white males; women and minorities are infrequently portrayed in technical roles. The report argues American society is influenced by the media and image is important because it compels individuals to ask themselves the question: “Can I imagine myself in that role?” Self-image impacts student career and educational path decisions. The report asserts many Americans “became lawyers because of *Perry Mason*, or became doctors because of many of the medical shows on TV . . . The problem is that there is not a very good image in the media for making high-tech, for making engineering, for making science really attractive” (Meares & Sargent Jr., 1999, pp. 56-57). The report concludes by making a recommendation that industry and government should open a dialogue with the entertainment industry as well as local and national media to encourage improving the depiction of technical professionals as well as expanding the role of women and minorities (Meares & Sargent Jr., 1999, p. 59).

## Demographics

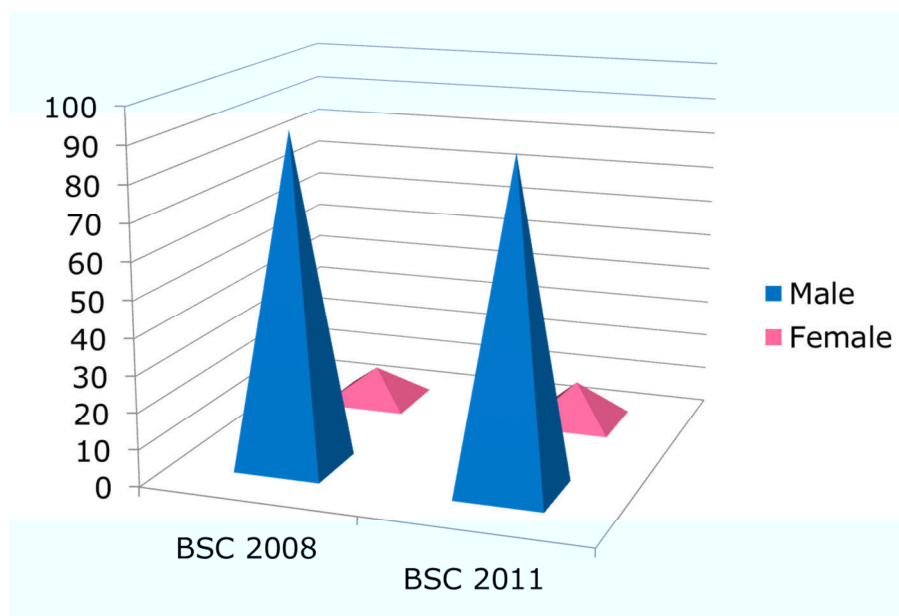
An additional challenge to increasing postsecondary college technology program enrollment is technology programs are still overwhelmingly dominated by male students, even as overall college enrollment now includes greater number of female students.

Nationally, between 1997–98 and 2007–08, the percentage of degrees earned by females fluctuated between 60 and 62 percent for Associate degrees and between 56 and 58 percent for Bachelor degrees, while the percentage of Master degrees earned by females increased from 57 to 61 percent (National Center for Education Statistics, 2010, pp. 216-217). In 2007-2008, the most recent year that nationally comparative statistics are available, females accounted for 57.3 percent of all Bachelor degrees conferred. At Buffalo State College, during the same period, females represented 62.5 percent of degrees conferred, or 1,104 of 1,776 graduates. For the year 2010-2011, the most recent data available, of the total baccalaureate graduates (1,841), females represented 59.9 percent of the total (1,103) (BSC Office of Facilities Planning and Institutional Studies, 2011, p. 1). This comparative information is represented in Figure 1.



**Figure 1. Percentage of male and female graduation rates for all Bachelor degrees both nationally and at Buffalo State College.**

Conversely, when gender of graduates of the six technology programs included within the scope of this study are compared during the same period, a dramatic shift occurs. At Buffalo State College, during the 2007-2008 academic year, males represented 90.8 percent of degrees conferred, or 99 of 109. For the year 2010-2011, the most recent data available, of the total undergraduate graduates (125) rates, males represented 88.8 percent (111). This comparative information is represented in Figure 2.



**Figure 2. Percentage of BSC graduation rates for six areas of study, 2008 and 2011, by gender.**

When comparing graduation rates to enrollment at Buffalo State College during the beginning of the fall 2011 semester, females represented 59.7 percent of the total student population, including graduate students, among whom 70.5 percent are female (BSC Office of Institutional Research, 2011, p. 1). At the undergraduate level, during the eleven year period 2000-2010, female enrollment at the undergraduate level fluctuated between a low of 57.6 percent (2010) and a high of 59.7 percent (2001 and 2004) (BSC Office of Institutional Research, 2011, p. 13). Overall, postsecondary college enrollment

is predominantly female (and increasing) while technology programs enrollment is predominantly male (and flat or decreasing).

The transition between high school and college is a critical time when many young women turn away from a Science, Technology, Engineering, and Mathematics (STEM) career path. While females represent the majority of college students, they are far less likely than their male peers to plan to select a major in a STEM field (Hill, Corbett, & St. Rose, 2010, p. 5).

Finally, BSC and many other traditional private and public nonprofit higher education institutions are also challenged by two related educational trends fueled by the rapid growth of the Internet: the growing popularity of 1.) private for-profit/nonprofit primarily online Internet colleges and 2.) professional certification programs.

### **Distance Learning**

Since the late 1990s, private for-profit/nonprofit primarily online Internet colleges, such as Phoenix University, have developed innovative curriculum development/delivery and compete with traditional nonprofit private and public colleges for students and tuition income streams. Enrollment in private for-profit/nonprofit primarily online colleges has nearly tripled in the last decade to more than 1.8 million students in 2008 (Hamilton, 2011, pp. C1-2). Private for-profit/nonprofit primarily online colleges have become leaders in curriculum access and delivery, offering Internet computer-based distance learning classes that can be attended anywhere public Internet computer network technology is available. Ironically, it is the proliferation of Internet-based computer technology which has allowed for-profit/nonprofit primarily online colleges to challenge traditional college technology programs.

For-profit/nonprofit primarily online colleges have led the charge in Internet-based distance learning curriculum development and delivery. However, these colleges and the value of the degrees they offer have been controversial. Associated Press national higher education reporter Justin Pope reported students enrolled at for-profit colleges (which rely on federal financial-aid programs for as much as 90 percent of their revenue), carry the largest loans in U.S. higher education. Bachelor's degree recipients at for-profit colleges have a median debt of \$33,050 compared with \$27,650 at private, nonprofit institutions and \$20,200 at public colleges (Pope, 2011, para. 4). While for-profit colleges currently enroll one in eight U.S. students, they account for almost one in two federal loan defaults, according to data released on September 13, 2010 by the U.S. Education Department (Hechinger, 2011, p. B7). In 2011, the total number of borrowers defaulting on federal student loans increased sharply, from four percent to 4.6 percent among students at private not-for-profit colleges. Still, this is much lower than the largest for-profit colleges. The default rate at the University of Phoenix rose from 12.8 to 18.8 percent. At ITT Technical Institute, where the default rate jumped from 10.9 percent to 22.6 percent (Pope, 2011, para. 12).

For-profit colleges' students also borrow heavily, receiving 24 percent of government-guaranteed student loans while accounting for only 12 percent of the U.S. college student population. For-profit colleges often cater to nontraditional, older students, or those in active military service (Hamilton, 2011, pp. C1-2).

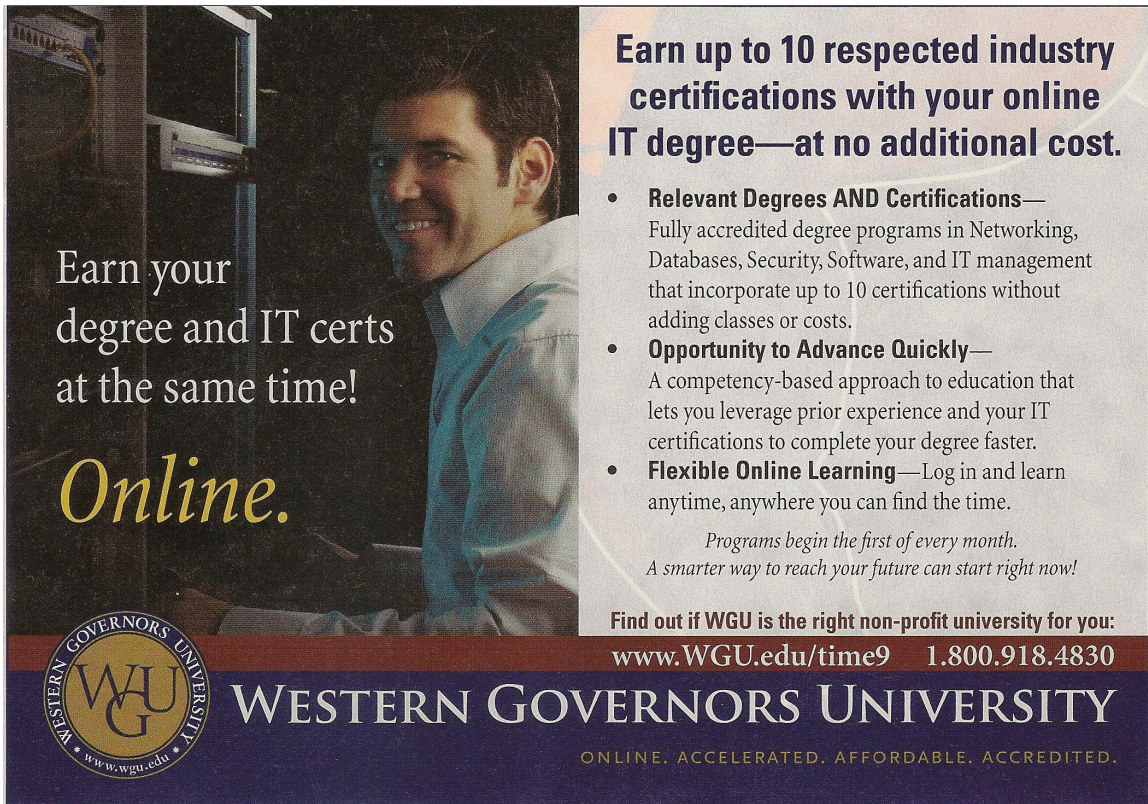
### **Professional Certifications**

Similar in many ways to the growth of for-profit colleges, is the rising popularity of professional certification programs. These programs, while different from field to

field, nonetheless have common characteristics. They are voluntary (versus being required by law or licensure), typically granted by either a for-profit company that supplies products or services (known as vendor-specific certifications), or from an independent for-profit or non-profit trade organization (known as vendor-independent certifications). The companies or organizations that grant a certification typically require some or all of the following for a certification credential: education, successful completion of one or more exams, and experience. Once obtained, certifications typically require occasional re-certification testing or continuing education activities (often referred to as Professional Development Units or PDU) in order for individuals to retain their certification.

While for-profit and nonprofit online colleges primarily cater to non-traditional college students, their growth both challenges traditional colleges technology programs and raises questions for students. Western Governors University (WGU) exemplifies some of the issues. Founded in 1997 and based in Salt Lake City, WGU is a private nonprofit, online-only university with more than 25,000 students, limited to U.S. citizens. It offers undergraduate and graduate degree programs in business, teacher education, information technology, and nursing. WGU's Bachelor of Science degree in Information Technology integrates certifications from CIW, Cisco, Microsoft, Oracle, and CompTIA. According to WGU's program website, certifications are integrated into its Information Technology curriculum so its students are "assured of an education that will give you the credentials you need to get ahead" (Western Governors University, 2011, para. 2). WGU advertises the integration of these prominent certifications as a competitive advantage against traditional technology programs and raises the question of whether professional

certifications are an important augmentation to a Bachelor of Science degree. WGU's advertisement is shown in Figure 3.



**Earn your degree and IT certs at the same time!**

*Online.*

**Earn up to 10 respected industry certifications with your online IT degree—at no additional cost.**

- **Relevant Degrees AND Certifications—** Fully accredited degree programs in Networking, Databases, Security, Software, and IT management that incorporate up to 10 certifications without adding classes or costs.
- **Opportunity to Advance Quickly—** A competency-based approach to education that lets you leverage prior experience and your IT certifications to complete your degree faster.
- **Flexible Online Learning—** Log in and learn anytime, anywhere you can find the time.

*Programs begin the first of every month.  
A smarter way to reach your future can start right now!*

**Find out if WGU is the right non-profit university for you:**  
[www.WGU.edu/time9](http://www.WGU.edu/time9) 1.800.918.4830

**WESTERN GOVERNORS UNIVERSITY**

ONLINE. ACCELERATED. AFFORDABLE. ACCREDITED.

Figure 3. Advertisement for WGU, an online nonprofit college, Information Technology B.S. integrated with professional certifications. *Redmond Magazine*, Oct. 2011 p. 25.

The impact of professional certifications on postsecondary technology education programs is timely. Professional certifications are aggressively being used for training to assist unemployed individuals to find a job, especially in the wake of the Recession of 2008. Since 2008, the unemployment rate has hovered at close to 10 percent and the underemployment rate (those working part time or for much lower wages than their full potential) is also close to another 10 percent. While the Recession of 2008 is not the deepest recession since the end of World War II (unemployment reached 11 percent in 1945), it has been the longest since 1945 (Reddy, 2011, p. G1).



In response to these economic challenges, the U.S. Department of Labor, Employment, and Training Administration created One-Stop Career Centers to serve the unemployed. U.S. Wired for Education is an Albany-based eTraining company that provides training for One-Stop Centers. Its Internet product, Metrix Learning, is designed to provide powerful, cost-effective distance learning curriculum delivery. Through the One-Stop program, job seekers have 90-day access to distance learning programs such as Metrix. One customer utilized the Six Sigma Green Belt content (a popular Industrial Technology professional certification) offered by SkillSoft and reported she passed the certification assessment exam on her first attempt. The training is cost-effective as well, since the Internet-based distance learning delivery was \$260, compared to a traditional classroom cost of \$2,500 (Lee, 2011, para. 3).

While this study does not explore whether professional certifications can replace the need for a baccalaureate degree to meet employment requirements, professional certifications' impact as a job-qualifying credential cannot be denied. Research on projected job openings and retirement trends in the workforce shows middle-skill jobs, those that require more than a high school diploma but not a four-year degree, comprise the largest share of jobs in New York State today (Wilczynski, 2011, p. 4).

At a national level, the Georgetown Center on Education and the Workforce has forecasted that there will be 47 million job openings by 2018. Sixty-three percent will require some college education, although nearly half will require an Associate's degree or less. However, it is anticipated those jobs will require the types of real-world skills validated by professional certifications (Carnevale, Smith, & Strohl, Help Wanted: Projections of Jobs and Education Requirements Through 2018, 2010, p. 26).

In April 2012 at a hearing of the Senate Subcommittee on Competitiveness, Innovation and Export Promotion, the acute need for postsecondary education and certifications to satisfy unmet manufacturing employment needs for which there are not enough qualified applicants was underscored. It was noted at the hearing most manufacturing jobs require computer literacy and formal certification of skills, some of which are generic, others highly specific. Those who meet the standards enjoy job placement rates in excess of 90 percent, above-average pay, good benefits and stable employment. Minnesota Senator Amy Klobuchar, chairwoman of the subcommittee, said: “We’re in a different kind of manufacturing now. There’s just a much better chance that when you get this ‘technical’ degree that you have a degree that you can use for life” (Spencer, 2012, p. B8).

Although professional certifications are not new, their recent growth and influence has left several questions unanswered as they relate to postsecondary college technology programs. There is a lack of clarity as to the value of professional certifications even as some have developed a reputation as being an important indicator for job preparedness. Employers may use professional certifications to differentiate and screen potential job candidates, even if they are not always certain of the worth of such credentials.

In addition, there is often no central clearing house or directory for professional certifications. Consequently, college students are often not aware of the existence of relevant professional certifications, nor are they aware as to how these certifications integrate with or augment a traditional college education.

Despite these ambiguities, studies suggest that professional certifications will continue to impact the development of college curricula (Randall & Zirkle, 2005, pp. 287-288). While some studies have been performed on the impact of professional certifications to postsecondary education, several questions remain unanswered: 1.) How are college technology education programs responding to the presence of professional, voluntary professional certification programs? 2.) Do students of baccalaureate technology programs need to pursue a professional certification in addition to obtaining their degree?

### **1.1 Statement of the problem and research questions**

Given the growth and recent federal legislation that acknowledges and promotes the use of professional certifications, the following were considered in forming the problem statement: students of baccalaureate technology programs within the scope of this study need to understand whether professional certification credentials are important for employment after graduation; what is the impact of postsecondary college technology program enrollment trends; the value and need for awareness of professional certifications; and which professional certifications are relevant and academically integrated into their field of study.

Using Buffalo State College as a representative U.S. baccalaureate technology program educational institution, this study addresses the problem statement by answering the following research question: What professional certifications are relevant to Buffalo State College's technology programs within the scope of this study; and to what degree

will graduates of technology programs be expected to augment their education with these relevant professional certifications?

To answer this question, the research contained in this study focuses on three aspects related to the problem statement.

**1.1.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** To baseline the impact of professional certifications on technology education, this study evaluates enrollment and graduation trends among the programs within the scope of this study.

In addition to analyzing enrollment trends of technology program, this study also measures perceptions among alumni and technology faculty of why enrollment is decreasing and how recruitment can be modified to increase enrollment.

Corollary: college technology program enrollments are decreasing due to perceptions of industry and employment prospects even as large numbers of baby boomers are retiring.

**1.1.2 Perceptions of student/employer value and awareness of professional certifications.** As graduates of Buffalo State College's technology programs seek employment, they may not have a full understanding of the need and relevancy of professional certifications. Is there a correlation between the growing popularity of professional certifications, distance learning and the stagnation of postsecondary college technology programs? Are associated professional certifications a requirement for seeking employment? Are they worth the time, energy and expense to obtain them? If a student perceives there is value in a professional certification, how does a student gain an

awareness of professional certifications relative to their field? Should a college have a responsibility to inform students of their existence?

Corollary: employers value professional certifications even as students may not fully understand their significance or awareness of their existence.

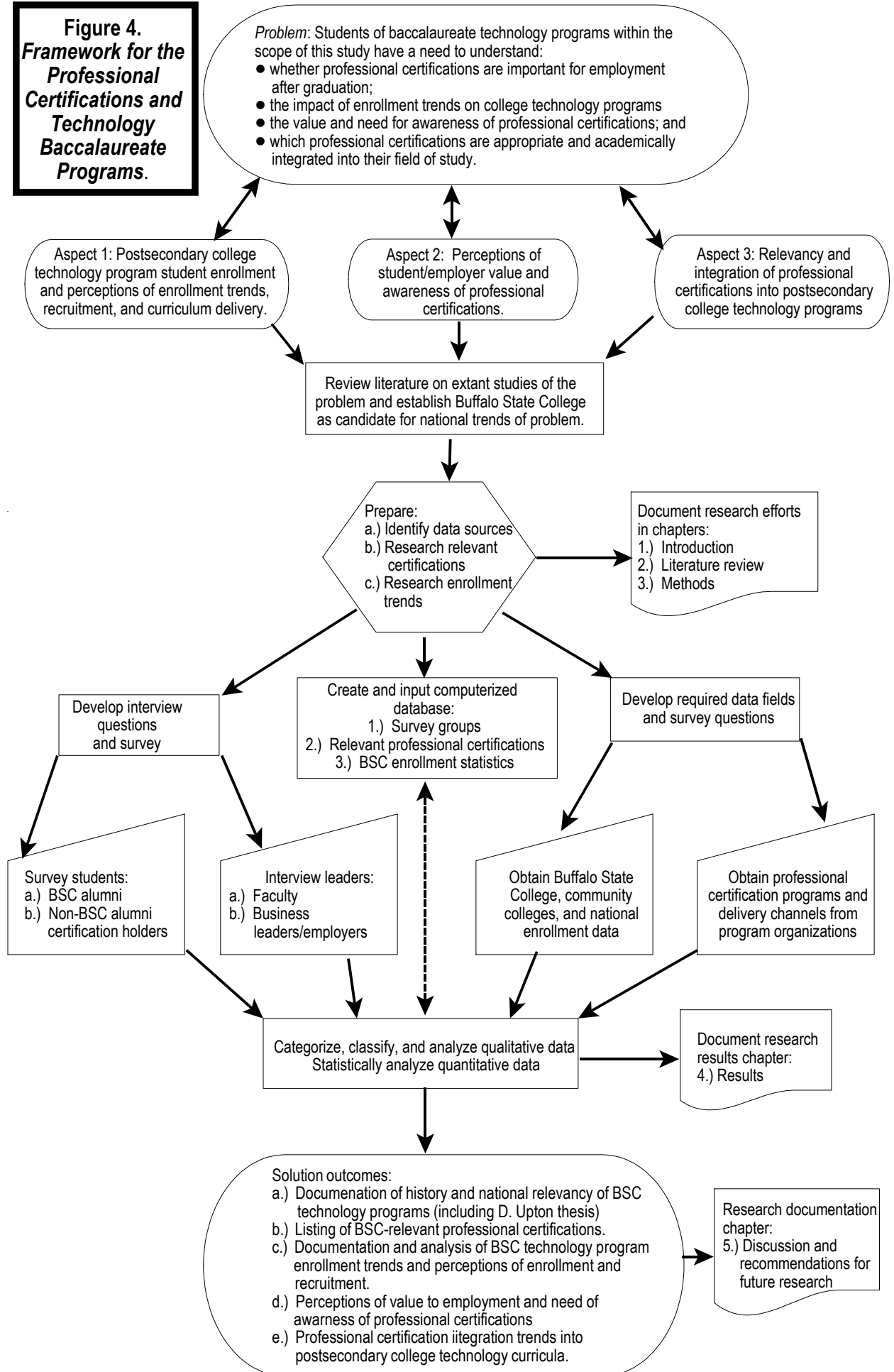
**1.1.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** With the growth professional certifications both in international communities and within the United States, some secondary and postsecondary educational institutions are adapting to the integration of professional certifications. Should Buffalo State College's curricula be modified to incorporate classes that prepare students for appropriate certification exams?

Corollary: professional certifications are increasingly becoming integrated into secondary and postsecondary academic institution technology programs.

There are, indeed, other facets to the stated problem. The researcher elected to contain the scope of this study by limiting the focus to these aspects.

**1.1.4 Framework for approach to problem.** Figure 4 illustrates the framework for the problem and the approach for researching the problem, more fully articulated in Chapter Three.

**Figure 4.**  
**Framework for the**  
**Professional**  
**Certifications and**  
**Technology**  
**Baccalaureate**  
**Programs.**



## **1.2 Background and need**

Since the 1870s, postsecondary technology programs in the United States have evolved as the nation has undergone a major shift in its economy from agriculture/manufacturing to services. At the turn of the twentieth century, the U.S. economy was based on farming, refinement of natural products, and manufacturing. Since then, the U.S. has undergone a shift to become a knowledge and service based economy. In 1991, for the first time, U.S. expenditures related to a knowledge/service based economy, including information and communication technologies, surpassed those for the industrial economy, \$112 billion to \$107 billion (Trilling, 2009, p. 3). Contrasted to a century before, in 2012 the manufacturing sector represents about twelve percent of the overall U.S. economy (Hall, 2012, p. B5).

Of the twelve largest firms in America at the turn of the twentieth century only one, General Electric, remains within the top twelve and many of the others no longer exist (Theodore, 2003, p. 277). Today, the twelve largest firms in the United States include those in banking, retail, insurance, as well as manufactured products (Forbes, Inc., 2010).

With shifts in labor and population from farm to factory, change continues to occur. Within a period of three decades, there has been a dramatic shift in the number of workers in the U.S. manufacturing sector which peaked in 1979 with 19.5 million workers and reached a new low of 11.7 million workers in 2011. The majority of these losses have occurred within the last two decades. The Economic Policy Institute asserts that more than 50,000 factories and six million manufacturing jobs have been lost since 1993 (Reddy, 2011, p. G1).

The national trend of fewer manufacturing jobs is also echoed within Western New York. The Buffalo Niagara region has lost over 10,000 manufacturing jobs, or about 18 percent, from 2007 to 2010. There were 60,900 employees in the manufacturing industry in December 2006 and 49,900 employees in December 2010, according to data from the New York State Labor Department (Tighe, 2011, p. B7).

While the decline in manufacturing employment is sometimes attributed to offshoring, the primary cause is American innovation and automation. Because of increased technology utilization, manufacturing productivity in the U.S. increased at an annual rate of 3.9 percent from 2000 to 2007, resulting in fewer workers needed to produce more products more quickly. Meanwhile, over the last century, low-tech, labor-intensive manufacturing has been moved to the lowest-cost country as costs escalate: from Great Britain to the United States to Japan, Taiwan/South Korea and more recently, to China, and other developing Asian countries including Vietnam as well as African countries. Yet these trends are cyclical. According to a study by the Boston Consulting Group, the United States will experience a manufacturing renaissance because of increasing global labor rates, fuel costs, and long-distance management expenses. Goods production that requires less labor will shift back to the United States, while labor-intensive production may remain abroad. Although some manufacturing jobs may shift back to the U.S., the vast majority of new jobs projected over the next decade will be in the service sector. Those manufacturing jobs that do return to the United States will require employees with postsecondary education including technology and management skills (Manzella, Shifting manufacturing trends lead to rise of 'backshoring', 2011, p. G2).



With the shift in the U.S. economy to high-tech knowledge, manufacturing, and service-based industries, there is a need for increased emphasis on technology education at the secondary and postsecondary level. Strengthening instruction in STEM subjects is a prerequisite to develop a well-prepared twenty-first century workforce. To meet this need, the Obama administration has announced an education initiative aimed at increasing STEM literacy and critical thinking, improving the quality of STEM teaching, and expanding STEM education and career opportunities with a focus on under-represented groups, including women and minorities (Cisco Systems, Inc., 2010, p. 1). The nation's foremost business executives have acknowledged the lack of STEM education and its potential negative impact to the economy. Robert G. Wilmers, Chief Executive Officer and Chairman of the Board of Buffalo-based M&T Bank said at its 2012 annual shareholders meeting: "Young people must be especially encouraged to consider science, technology, engineering and mathematics courses, which provide the sort of preparation vital to our economy" (Epstein, 2012, p. B7).

Within New York State, just as at the national level, an economic transition is taking place, changing from a traditional "rust belt" manufacturing base to new high-tech manufacturing and service sectors including health care, advanced manufacturing, green technology, information technology, and transportation. In response to the Recession of 2008, federal investment funds flowed into New York State to increase employment prospects. Yet many jobs remain unfilled because of a shortage of skilled workers for middle-skills jobs: those that require more than a high-school diploma, but less than a four-year college degree (Wilczynski, 2011, p. 4).

To prepare employees for jobs that require more than a secondary education, institutions that offer technology programs such as Buffalo State College and similar postsecondary educational institutions across the country as well as professional certification programs incorporate the concept of applied learning. In contrast to theoretical learning, applied learning motivates and challenges students to connect their experiences in the world to traditional academic theory. Proponents of applied learning, sometimes referred to as contextual learning, believe when academic content is made more relevant, participatory and concrete, students have a thorough command of the subject matter, retain the subject matter for a longer period of time and apply what they have learned to their personal and professional lives to incorporate problem-solving approaches (California Department of Education, 1995, pp. AL-1).

The concept of applied learning as it relates to technology education may seem redundant, as the term technology, a combination of the Greek *téchnē*, (an art, skill or craft) with *logos*, (word or speech, now used to represent a field of study) meant a discourse on the arts, both fine and applied. When the term technology was first used in the English language during the seventeenth century, it was used to describe a discussion of the applied arts only (Buchanan, 2011). In the United States during the nineteenth and early twentieth centuries the term technology was used to describe “all tools, machines, utensils, weapons, instruments, housing, clothing, communicating and transporting devices and the skills by which we produce and use them” (Bain, 1937, p. 860). While over 70 years old, this definition remains common among scholars today. For example, Buffalo State College’s Technology Education program currently defines technology as the “application of knowledge, tools, resources, and processes to develop solutions to

human problems and challenges” (Greene C. , 2007, 2012). The term technology may also be used to describe any applied theoretical science, especially among scientists and engineers (MacKenzie & Wajcman, 1999, p. 3).

While the scope of this study analyzes postsecondary baccalaureate technology programs as career-preparedness vehicles, the researcher acknowledges the pursuit of a traditional college education has important objectives beyond the goal preparing students for employment. Dr. Martin Luther King Jr. may have summed up the value of the so-called soft-skills that are part of a postsecondary college education when in February 1947 he said:

It seems to me that education has a two-fold function to perform in the life of man and in society: the one is utility and the other is culture . . . The function of education, therefore, is to teach one to think intensively and to think critically . . . Intelligence plus character—that is the goal of true education. The complete education gives one not only power of concentration, but worthy objectives upon which to concentrate (King Jr., 1992, p. 124).

The noted theologian and educator, John Henry Newman, wrote that pursuit of knowledge will rescue a student “from that fearful subjection to sense which is his ordinary state” (Newman, 1899, p. 184). The point, that knowledge will help a person move from infatuation with externals and towards worthy considerations, has been repeated by philosophers for at least 3,000 years (Harris, 1991). Newman stated the purpose of a liberal arts education was to “open the mind, to correct it, to refine it, to enable it to know, and to digest, master, rule and use its knowledge, to give it power over its own faculties, application, flexibility, method, critical exactness, sagacity, resource, address and eloquent expression” (Newman, 1899, p. 122). Newman seemed to underscore the value of a traditional education producing a well-rounded student when he

warned if a student's studies are "confined to simply one subject, however such division of labor may favor the advancement of a particular pursuit . . . certainly it has a tendency to contract his mind" (Newman, 1899, p. 100).

Even with Newman's warning of the need to provide a moral compass as part of a student's education, in the U.S. during the nineteenth century there was a movement towards secular-based technical colleges that incorporated both liberal arts and employment preparation curricula. Their origins can be traced to the Morrill Act of 1862 that established land-grant technical colleges. Since then, growth in both technology and technology education has been rapid. Applied technology education in the U.S. has progressed since the 1876 Philadelphia Centennial Exposition where the concept was first exposed to a broad American audience. The learning theories associated with technology education have changed little from applied technology education's inception, but its scope and extent has evolved dramatically in the ensuing 135 years. From manual training, to vocational industrial education, to industrial arts, to vocational technical education to what is today referred to as technology education and career/technical education, there has been continual change within postsecondary technology programs, reflecting evolving societal needs and the introduction of new technologies.

The influential educational reformer and prolific author John Dewey (1859 – 1952) often pointed out the role of education in social reform. Dewey believed education has always been vocational and the inclusion of what is now referred to as career and technical education marks a more inclusive, democratic approach to education. Dewey said:

Existing cultural elementary education is largely vocational, but that the vocations which it has in mind are too exclusively clerical, and too much

of a kind which implies merely ability to take positions in which to carry out the plans of others . . . So-called cultural education has always been reserved for a small limited class as a luxury. Even at that it has been largely an education for vocations, especially those vocations which happened to be esteemed as indicating social superiority or which were useful to the ruling powers of the given period. Our higher education, the education of the universities, began definitely as vocational education . . . and furnished training for the priesthood, for medicine and the law. Whenever any study which was originally utilitarian in purpose becomes useless because of a change in conditions, it is retained as a necessary educational ornament (as useless buttons are retained on the sleeves of men's coats) or else because it is so useless that it must be fine for mental discipline (Dewey, *Learning to Earn: The Place of Vocational Education in a Comprehensive Scheme of Education*, 1917, p. 331).

There is also a distinction between education and workforce development training. Academic education is often viewed as exercises which build analytical skills, knowledge, and critical thinking. Workforce development training builds craftsmanship, practical experience and practical problem-solving. However, this distinction is not so clearly defined. For example, critical thinking and analytical skills are needed by tradesmen who make judgments to solve problems (Education International, 2009, p. 5). Nonetheless, a Bachelor's degree generally indicates an individual has a knowledge base that allows him or her to participate in society as a professional. However, workforce development training is a more specific form of knowledge. As is evidenced in the remaining chapters, there is debate as to where professional certifications fall within this spectrum, however, they generally indicate proof of competence within a specific technical field or specific technology.

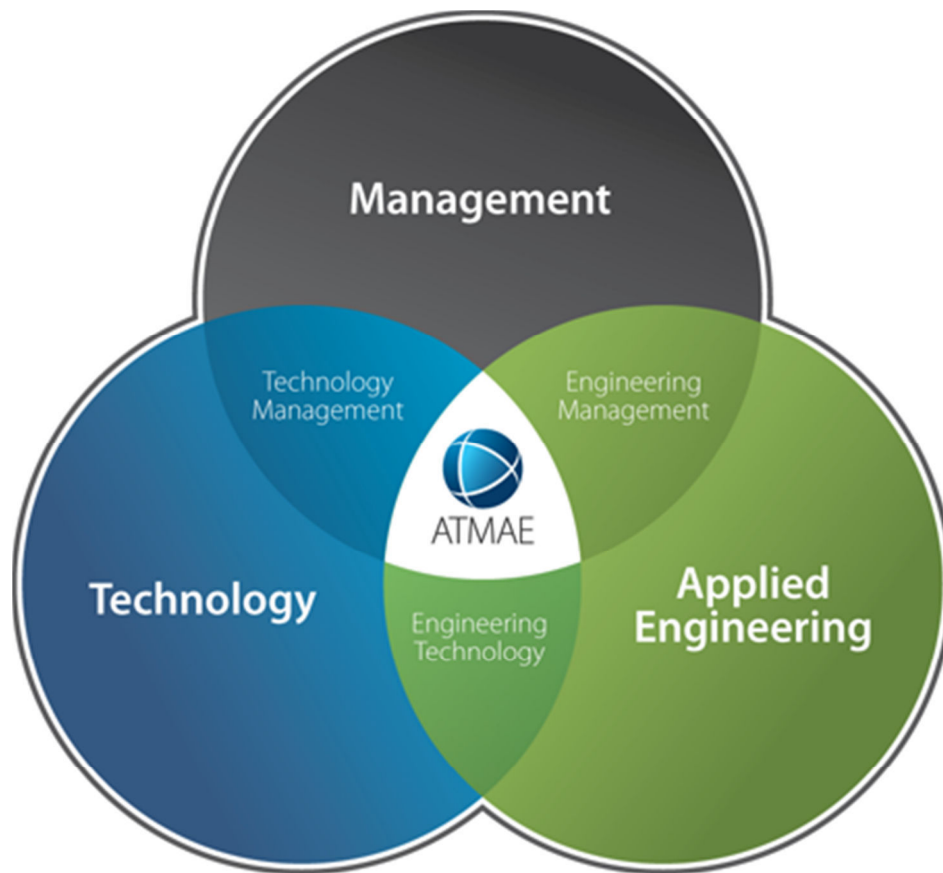
If, as Dewey suggests, most education is vocational in nature, it certainly applies to the programs within the scope of this study. The academic programs within the scope of this study and of their associated professional certifications incorporate four key elements that underscore their vocational nature: 1.) education, 2.) technology, 3.)

industry, and 4.) society (Foster P. N., Technology Education: AKA Industrial Arts, 1994, p. 18). In 1985, the American Industrial Arts Association (now the International Technology and Engineering Educators Association, ITEEA) defined technology education as “a comprehensive, action-based educational program concerned with technical means, their evolution, utilization, and significance; with industry, its organization, personnel systems, techniques, resources, and products, and their socio-cultural impacts” (American Industrial Arts Association, 1985, p. 25).

This general definition that incorporates technology and education can be applied to the specific technology disciplines within the scope of this study. As with most technology definitions, they are updated periodically. In 2003 the definition of computer science was updated to include “the study of computers and algorithmic processes including their principles, their hardware and software design, their applications, and their impact on society” (Tucker, et al., 2003, p. 6). This specific technology discipline definition incorporates the general concepts of education, technology, and society.

The general concept of technology education can also be applied to the specific technology education instance of a professional certification. The Association of Technology, Management, and Applied Engineering (ATMAE) is an organization that sets standards for academic program accreditation, personal certification, and professional development for educators and industry professionals involved in integrating technology, leadership and design. Their definition of industrial technology includes three major components that generally correlate with the AIAA/ITEEA definition with the exception of education: 1.) management, 2.) technology, and 3.) applied engineering.

These three components are critical to success and underscore the need for applied learning for business success. The diagram is included in Figure 5 (ATMAE, 2010).



**Figure 5. Venn Diagram developed by Dr. John R. Wright, Jr. on behalf of the 2008-2009 ATMAE Executive Board. Copyright 2009 ATMAE.**

Because of the educational inclusion of both theoretical and applied learning, many postsecondary college technology programs, including those at Buffalo State College, attempt to produce well-rounded and employable graduates by providing the skills necessary to obtain employment in industry.

Even as enrollment is dropping or stagnating at a national level in several postsecondary college technology programs, there has been impressive growth in the development and popularity of professional certification programs. These programs have

evolved since first emerging about 40 years ago and rapid growth has occurred within the last 20 years. In the computer information sector, the first certification credential was the Certified Novell Engineer (CNE), created in the late 1980s (Christianson, 1998, p. 241). Since that time, there are now well over 300 computer certifications and several million certifications issued (Adelman, 2000, p. 3). The growth of professional certifications also parallels the growth of Internet-based for-profit colleges (ITT Educational Services, Inc., Corinthian Colleges, and University of Phoenix). Besides innovative distance learning curriculum development and delivery systems, both professional certification organizations and Internet-based for-profit colleges have in common national or international recognition, unlike a degree from a regional institution of higher learning.

As a result of the growth of professional certifications and Internet-based distance learning, they both have impacted traditional degree-granting postsecondary educational institutions. Most students attend college to prepare for a career and many employers prefer the broad grounding that students in college technology programs receive. The program's scope typically includes a strong background in theory coupled with applied learning with exposure to a variety of technologies through labs and industry cooperative programs. Baccalaureate programs also provide education for students in the classic and the arts to develop critical thinking, oral and written communication skills, as well as awareness of rich, multi-cultural global society in which we live.

Professional certifications provide a credential showing mastery of a particular technology discipline. While there are similarities between technology certification education and postsecondary technology education, certification integration with postsecondary college technology programs remains rare. Some certification programs



can be created and retired before an academic review can be performed. Many colleges and universities are particularly adverse to vendor-specific certification integration because of concerns of loss of educational independence. However, at some point technology theory must intersect with the real technology products and solutions that businesses implement. Because of this, certifications have wide appeal and value to a variety of audiences, including academia.

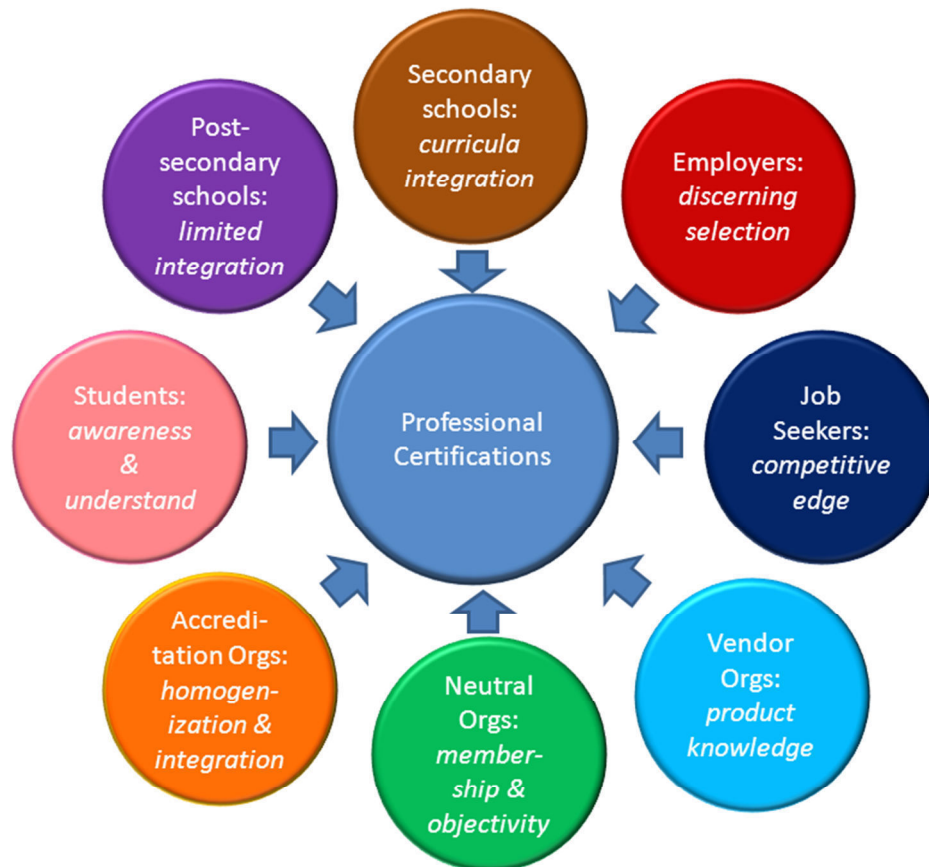


Figure 6. Value of professional certifications from perspective of stakeholders within scope of this study.

**1.2.1 Professional Certifications Value Perspective.** With the rise in popularity of professional certifications, their impact is different to the various stakeholders invested in them. Within the scope of this study, eight stakeholders have been identified. The stakeholders are represented graphically in Figure 6.

**1.2.1.1 Students.** Students at a secondary and postsecondary level seek understanding of how professional certifications can impact their technology program and their impact on further education or jobs as well gaining a greater understanding of their specific field of work.

**1.2.1.2 Job Seekers and Holders.** Professional certification programs have become a key entry point into some technology jobs, particularly information technology/computer information systems jobs. These programs are attended by a wide range of prospective job seekers/holders, including: 1.) college graduates with information technology degrees interested in developing an expertise in a particular area, 2.) college graduates with no technology backgrounds that desire to move into technology jobs, and 3.) those with technical aptitude but no college degrees.

Certifications are of importance when an applicant is in the job market and the credential is used to show an interviewer the applicant understands a specific technology within the scope of a particular professional certification. The second most popular use of professional certifications is as an effective method for experienced employees to change roles within the industry or obtain promotions and salary increases within their current job (Karlin, 2006, p. 58).

Professional certification programs offer a relatively quick path to technology jobs, though generally at the lower or entry-level end of the occupations. There remains considerable debate over whether this type of training alone provides sufficient foundation for moving into higher-level technology jobs and for transitioning into new technical areas necessitated by the rapid advance of information technologies (Meares & Sargent Jr., 1999, p. 39).

While many technology jobs require a four-year college degree, entry level positions often only require occupational credentials and offer career advancement opportunities with additional training and education (Wilczynski, 2011, p. 12). For prospective technology employees, professional certifications hold much allure because they provide a means by which job applicants can indicate their current and specific skills (Hunsinger & Smith, 2008, p. 261). Many professional certification credentials are nationally or internationally recognized, compared to variable and unknown quality of regional higher-education institutions.

In addition, professional certifications are attractive to job seekers because a certification is a credential that follows the individual wherever he or she goes. It typically demonstrates a commitment to learning beyond formal higher education programs in engineering, science, or technology. The existence of professional certifications may be viewed through the lens of America's changing business climate and an expectation that citizens will no longer work for the same employer for their entire careers. Employability now requires lifelong learning and constant preparation for change. Recessions, downsizing, outsourcing, and labor cost reduction are today's realities. The U.S. Department of Labor predicts engineers, on average, will change jobs every six or seven years (Merle, 1999, p. 40).

Even more important than being prepared for career changes, organizational change within an existing company also requires retraining. John Manzella, author of *Grasping Globalization* said in a 2011 editorial: "Today's only sustainable competitive advantage is knowledge, the driver of innovation . . . [therefore] employees need to continually enhance their skills. . . the future success of American businesses very much

will depend on their ability to find talented employees who can quickly learn new skills and implement increasingly sophisticated technologies” (Manzella, Today's critical jobs issues are tomorrow's drivers of growth, 2011, p. G2).

Finally, while there has been some emphasis on certifications’ positive impact on salary, in In *Redmond/ Microsoft Certified Professional* magazine’s 2011 (sixteenth annual) IT Salary Survey, most of the 1,475 respondents indicated they were not interested in pursuing certifications solely for their potential impact on their salary, but were more interested in how certification and training can help to improve their technical knowledge. As far as motivations for pursuing professional certifications, 71 percent of respondents said obtaining certifications was a personal goal, while 48 percent said certification would help them distinguish their skills from others. Thirty two percent said it provided leverage when seeking a better job. The study concluded by asserting certifications offer significant value to those seeking jobs, even if that value could not be quantified in financial terms (Domingo, 2011, p. 35).

**1.2.1.3 Employers.** Professional certification is one of the most significant trends in human resources professional development. Successful companies increasingly turn to the growing movement toward voluntary professional certification for recruitment or career development (Barnhart, 1997, p. xvii).

Professional certifications give companies a tool to assess job candidates and for their existing employees, a benchmark to ensure the competence and currency of key personnel. Often, human resources departments have no other way to know if a candidate is suitable for a particular job requirement.

Professional certifications also offer a company another key benefit for its existing employee base. As part of the growth of service-based businesses, the benefits of professional certification to employers include increased service excellence. With an increased emphasis on technology service delivery excellence, many companies are working to improve key service metrics. One way of improving company performance is to increase the overall performance or skill of its key teams. In a study published in 2006, the research demonstrated that for each new team member certified in his or her job function, team performance increases. Therefore, the study concluded, a concentration of professional certifications within a team is linked to its performance and service excellence. According to the study, organizations were recommended to strive to have between 49 percent and 55 percent of its team certified in relevant technologies and processes (Anderson & McStravick, 2006, p. 5).

Employers may also have another important benefit based on the number of its employees being certified in a particular technology. In these days of increasing internal and external company financial and risk audits, the greater the number of employees who are certified, the more favorable company is designated an audit risk rating (Russell, 2011).

***1.2.1.4 Vendor-neutral professional certification organizations.*** Professional certifications are provided by one of two types of organizations. The first, vendor-neutral, are typically membership-based trade organizations or not-for-profit organizations that seek to increase professionalism within a specific technology field. Examples of vendor-neutral certification organizations include the American Society for Quality (ASQ), the Society of Manufacturing Engineers (SME), and the Computing

Technology Industry Association (CompTIA). For these organizations, professional certifications are a way to increase membership within the organization or provide an objective technology credential that is not tied to a specific company-based technology.

**1.2.1.5 Vendor-specific professional certification companies.** The second category of provider of professional certifications is vendor-specific. Examples of companies that develop vendor-specific certifications include CNC Software, Microsoft, and Cisco Systems. These certifications are typically provided by for-profit companies that manufacture technology products. For these companies, professional certifications are a way to increase product-specific knowledge, ensure their products are implemented correctly, and to help drive sales. Frequently, employees with professional certifications in a particular technology are in a purchasing decision-making capacity.

**1.2.1.6 Accreditation organizations.** Non-profit accreditation organizations fall into two subcategories: 1.) organizations that accredit professional certifications for postsecondary college credit, and 2.) organizations that accredit college technology programs which may include or be integrated with professional certification programs. An example organization of the former is the American Council on Education (ACE) and the latter is Association of Technology, Management and Applied Engineering (ATMAE). For both of these organizations, professional certifications offer the ability to homogenize disparate technology programs and to integrate professional certifications with college credit.

**1.2.1.7 Secondary schools.** Secondary schools make extensive use of professional certifications, integrating them into their technology programs and utilize them as an independent assessment tool. For example, Boards of Cooperative

Educational Services (BOCES) schools integrate Cisco and CompTIA certifications into their programs.

**1.2.1.8 Postsecondary schools.** Within the scope of this study, postsecondary schools fall into three sub-categories: 1.) employment training, 2.) junior/community colleges, and 3.) baccalaureate educational institutions. The value to each of these institutional types is similar, although their student characteristics are different. For employment training or adult education institutions, professional certifications are highly valued for their ability to provide a credential of value to employers and job candidates. For these institutions, integration of programs with professional certifications is highly valued. Associate degree granting community colleges that focus on career-readiness also highly value integration with professional certifications to provide its graduates with two credentials, a regionally-recognized two-year college degree and nationally or internationally recognized specific industry credential, such as Cisco's CCNA certification.

For four-year postsecondary technology schools, the value of professional certifications is similar to two-year colleges, yet is not as widely adopted as two-year schools; therefore it is the focus of this study.

For both two and four-year schools, professional certification programs also offer something else of great value: the opportunity for a homogenization of regional college technology programs. In a recent study focused on Industrial Technology certifications, Dr. Ron Meier suggests professional certification programs can be used to create an industry-wide branding forming a "consensus on what actually is the appropriate common core for a program that prepares Industrial Technologists" for employability.

The study revealed broad discrepancies among the core competencies of ATMAE-accredited Industrial Technology programs (of which BSC is one). The study asks: how can employers understand what skills a graduate of a technology program possesses when there are significant gaps in the core competencies among various accredited programs? ATMAE professional certifications (and others like them) can provide a universal measurement of proficiency in a particular discipline, regardless from which college a student graduated (Meier & Brown, 2008, p. 3). This issue, while relevant to all the technology programs within the scope of this study, is especially relevant to Industrial Technology programs. In his 1973 study of the national history of several four-year Industrial Technology college programs, Dr. Talbott said “Unlike engineering and engineering technology curricula, industrial technology has not been endowed with a distinctive title, philosophy and objectives by a national agency. There is as much diversity as commonality among existing programs” (Talbott, 1973, p. 8). Technology programs at colleges integrated with professional certification programs have international industry experts who specify outcome-based standardized curricula (Kelly, 2011, p. 10).

Because professional certifications bring homogeneity to regionally-based postsecondary college technology programs, they have global appeal, even though many organizations that issue them are based in the United States. In a study conducted by the Institute of Industrial Engineers (IIE), it was noted a large number of IIE certification holders live outside the United States. The study pondered the question, “Could a broader-based certification serve in place of the P.E. as a credential beyond the engineering diploma?” (Merle, 1999, p. 40).



For these reasons, there is a need for this study because students do not fully grasp the need for professional certifications, even though employers use them to differentiate candidates for jobs. To the best of the researcher's knowledge, there is no current study that shows the need or desire by students to learn more about professional certification programs.

### **1.3 Purpose and theoretical orientation**

**1.3.1 Purpose statement.** The purpose of this study is to correlate Buffalo State College's technology programs within scope to relevant professional certifications and to measure the perceptions on enrollment trends, certification value/awareness and postsecondary college integration from the perspective of program alumni, faculty, employers, and non-alumni or certification holders.

**1.3.2 Need for the study.** As the need increases within the United States for technology jobs, STEM enrollment is decreasing. Math, science and engineering courses were not popular compared to social science courses and programs. Of the 1.6 million Bachelor's degrees earned in 2009, the most popular fields were: business (21.7 percent), social sciences and history (10.5 percent), health professions (7.5 percent), education (6.4 percent), and psychology (5.9 percent) (Chen, 2011, p. C2). This study is relevant because it provides an assessment of enrollment trends and measures trend perceptions. In addition, the role of professional certifications, as they relate to Buffalo State College technology programs, is clarified. This study, therefore, will resonate with technology employers, faculty and students. Employers will find value in the study as they will gain a better understanding of the motivations and value of various professional certifications that relate to specific jobs. Faculty members will find the study valuable because they

will gain a better understanding of how students select their majors and the value and role they place on professional certifications. Prospective and current postsecondary technology students will find the study valuable as they gain a broader understanding of the role and importance of both traditional technology curriculum as well as the value of professional certifications.

Because of the trends in declining enrollment of traditional technology programs accompanied by the growth of professional certifications, this study assesses the history of Buffalo State College's technology programs as a specific example of many similar schools throughout the United States.

Another reason for the need of the study is the impact of retirees in the coming years. There will be an imminent mass retirement of baby boomers, which will deplete the ranks of U.S. technical staffs, and a shortage in trained replacements due to a smaller population of college graduates with technical degrees. The U.S. Census Bureau defines baby boomers as those born between January 1, 1946 and December 31, 1964.

Beginning in January 2011, more than 7,000 baby boomers a day will turn 65, more than 78 million through 2030 (2011 a boom year for baby boomers, 2011, p. A3). Of the 47 million job openings anticipated to be filled in the U.S. by 2018, 33 million will be created by retiring baby boomers (Carnevale, Smith, & Strohl, *Help Wanted: Projections of Jobs and Education Requirements Through 2018*, 2010, pp. 26, 70). Despite concerns the Recession of 2008 might delay boomers' retirement, a 2012 study by MetLife, Inc. asserted the recession generally would not delay retirement plans (Gores, 2012, p. C3).

**1.3.3 Description of the study.** An assessment of select technology programs at Buffalo State College was undertaken, the specific six undergraduate degree programs were:

1. Computer Information Systems, B.S.
2. Electrical Engineering Technology: Electronics, B.S.
3. Electrical Engineering Technology: Smart Grid, B.S.
4. Industrial Technology, B.S.
5. Mechanical Engineering Technology, B.S.
6. Technology Education, B.S.

With the exception of Computer Information Systems, the programs within scope are under the hierarchy of Buffalo State College's Technology Department. Those remaining include all the Bachelor degree programs offered within the Technology Department except for Fashion and Textile Technology, excluded from the scope of this study because of its association with the College's historic Vocational Homemaking Department (further referenced in Chapter Two). Also excluded from the scope of this study was Buffalo State College's Career and Technical Education (CTE) program. Although the primary descendent of Buffalo State's original Vocational Industrial program, as of August 2011 the program is part of the School of Education/Career and Technical Education Department (Buffalo State College Relations Department, 2011, p. 4). The program's students are certified by the New York State Education Department and degrees are certified by the National Council for Accreditation of Teacher Education (NCATE) through the International Technology and Engineering Educators Association (ITEEA). Many of the CTE students become BOCES teachers and may need to pursue voluntary credentials to prove their skills. Therefore, the relevance of professional certifications to New York State certified technology teaching programs is represented by

the Technology Education program and by the specific technology disciplines represented by the five other programs within the scope of this study.

While Computer Information Systems is presently not within the Technology Department at Buffalo State College, it is included in the scope of this study because of its historical associations with the Technology Department; its foundational principles exhibit similar characteristics to other technology programs; and because of its rich association with professional certifications. Both the Technology and Computer Information Systems Departments are part of Buffalo State's School of the Professions.

**1.3.3.1 Procedure.** Within the scope of the programs included for this study enrollment and graduation data for the period of 2000 – 2011 was gathered and analyzed quantitatively. Secondly, an inventory of existing professional certification programs relevant to the six technology programs was created using a survey sent to certification organizations. The resulting data were analyzed quantitatively.

Thirdly, surveys and qualitative interviews were conducted to assess reasons for technology program enrollment as well as perceived value and impact of relevant professional certification programs to the technology programs in the scope of this study. Surveys were limited to program alumni within scope while interviews were conducted with alumni, faculty, employers, and non-alumni/certification holders.

**1.3.4 Expected outcomes.** It is expected the study will show a defined correlation between professional certification programs and associated technology programs as well as provide answers to the questions being studied.

### **1.4 Assumptions, limitations, and ethical considerations**

This study is limited to six technology programs offered at Buffalo State College and to associated relevant professional certifications. The researcher has strived to ensure research was conducted in an ethical manner. Details of the study methods are found in Chapter Three.

### **1.5 Significance to the field**

While there has been a few studies published on the value of professional certifications, they have typically been limited to information technology certifications (Quan, Dattero, & Galup, 2007, p. 81). There has never been any formal assessment of the perceived value of technology programs at Buffalo State from the alumni's perspective. This study will provide that correlation and the results can be extrapolated to have significance to many similar colleges throughout the United States.

### **1.6 Definition of terms**

***Certificant*** – An individual who holds a professional certification. The term was coined by Novell.

***Computerized Adaptive Testing (CAT)*** – A computer-based test where the test adapts itself by selecting the next item to be presented on the basis of performance on preceding items. If a test taker performs well on a set of intermediate-level questions, the computer will proceed to a set of advanced-level questions. If the test taker performs poorly on intermediate-level questions, the next question set will contain novice-level

items. Testing stops when the performance at a given level is shown to be the test taker's highest sustainable performance.

***Criterion-based certification*** – Professional volunteer certification that requires candidates to meet a set of predetermined criteria for certification. Programs may require candidates to hold association membership and show a minimum number of years in the profession. Little or no attempt is made to objectively evaluate a candidate's job knowledge or competency.

***Competency-based certification*** – Professional volunteer certification that requires candidates to prove their expertise, mastery, or capacity within their profession. Examinations, professional education and experience requirements are based, in part, on a set of tasks identified by a job analysis. Candidates must show their mastery of a common body of knowledge within their profession.

***Education*** - A formalized process that builds analytical skills, knowledge and critical thinking (Education International, 2009, p. 5).

***Industrial arts*** - A subject of study aimed at developing the manual and technical skills required to work with tools and machinery and master the arts of being industrious.

***Industrial technology programs*** – Consists of degree programs of study designed to prepare management oriented technical professionals in the economic-enterprise system. Industrial Technology degree programs and professionals in Industrial Technology careers typically will be involved with: (a) the application of significant knowledge of theories, concepts, and principles found in the humanities and the social and behavioral science, including a thorough grounding in communication skills; (b) the understanding and ability to apply principles and concepts of mathematical and physical

sciences; (c) the application of concepts derived from, and current skills developed in a variety of technical disciplines including, but not limited to: materials and production processes, industrial management and human relations, marketing, communications, electronics, and graphics, and may include (d) a field of specialization, for example, electronic data processing, computer integrated design and manufacturing, construction, energy, polymers, printing, safety, and transportation (Keith, 1986, p. 22).

***Manual training*** - A course of training to develop skills, confidence, and manual dexterity in practical arts such as woodworking or handcrafts.

***Normal school*** - A nineteenth and early twentieth century term for a school that trains teachers, chiefly for the elementary grades.

***Performance based testing*** – An examination approach wherein candidates must interact with real or simulated systems.

***Professional certification*** – A voluntary, nationally or internationally recognized non-governmental process for ensuring professional competency based on standards and requirements to ensure a requisite knowledge, skills, and abilities to perform at the pre-determined level in the profession.

***STEM education*** – Science, technology, engineering and mathematics.

***Technology*** - The application of scientific knowledge transferred into a physical environment and the study of the creation and utilization of adaptive systems including tools, machines, materials, techniques and technical means and the relation of the behavior of these elements and systems to human beings, society, and the civilization process. The concepts of technology follow the hierarchy of: 1.) natural science (knowing about the world); 2.) technology (applying scientific knowledge to solve

problems); and 3.) engineering (knowledge to develop systems) (DeVore D. P., 1980, p. 4).

***Technology education*** - The study of how people modify the natural world to suit their own purposes and the diverse collection of processes and knowledge that people use to extend human capabilities and to satisfy human needs and wants (International Technology Education Association, 2000, pp. 4-7).

***Vendor-specific certification*** – Certifications administered by specific vendors.

***Vendor-neutral certification*** – Certifications created and administered by a consortium of vendors or not associated with one specific vendor.

***Vocational technical education*** - Training for a specific vocation in industry, or agriculture, or trade.

***Workforce development training*** – A process that develops craftsmanship, practical experience and practical problem-solving skills (Education International, 2009, p. 5).

## **1.7 Format of the thesis**

The format of the thesis will utilize both qualitative and quantitative analysis features and written according to APA standards, sixth edition (American Psychological Association, 2010).

In Chapter One, the researcher has reviewed background of technology education and professional certifications and the need to research technology enrollment trends, the value of professional certifications, the need for students' awareness of them and their integration with postsecondary college technology programs. In Chapter Two, the



researcher will review and synthesize the existing body of literature relevant to the topic and provide a chronology of Buffalo State College's technology program evolution.

Chapter Three will present the method of researching the problem. Chapter Four will present the results of the research and Chapter Five will discuss the conclusions of the research. An encapsulated summary, or roadmap, of the thesis research is depicted in Figure 7.

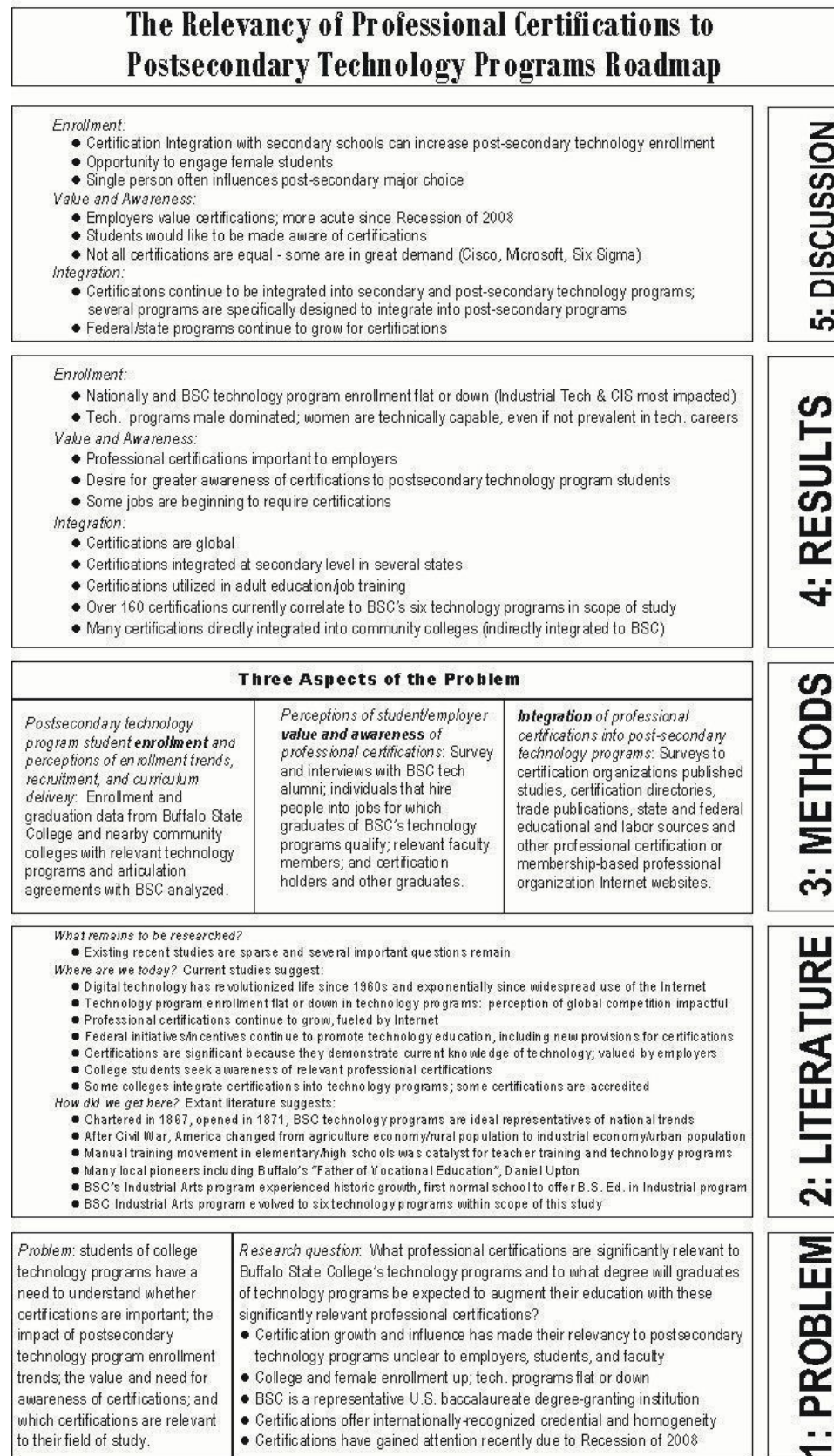


Figure 7. Roadmap of professional certification problem.

## **Chapter Two: Review of the Literature**

### **2.1 Introduction**

The research question addressed in this study is: What professional certifications are relevant to Buffalo State College's technology programs within the scope of this study; and to what degree will graduates of technology programs be expected to augment their education with these relevant professional certifications? It is these three aspects that form the basis for addressing the question: 1.) postsecondary college technology program enrollment trends, 2.) professional certification value/awareness, and 3.) professional certification relevancy and integration into postsecondary college technology curricula.

The researcher has found most academic studies related to whether professional certifications may augment baccalaureate degrees focus primarily on the Computer Information Systems/Information Technology program. However, the underlying concepts and results associated with these studies are applicable to any of the technology areas addressed in this study. Similarly, this researcher also found many professional certifications are heavily weighted in the Information Technology sector.

This listing of professional certifications relevant to BSC's technology programs is found in Appendix Five, an outcome of this study. This addresses a research gap since there does not appear to be any existing literature or comprehensive assessment of professional certifications that are relevant generally to technology programs (see Appendix Five). The programs specifically addressed in the scope of this study are especially in need of further assessment as they relate to certifications. One of the reasons for the dearth of literature may be the constantly changing nature of

certifications. The state of professional certifications must mature as the fields grow. Because of the recent rapid growth of professional certifications, the few directories that were published are now obsolete and out of print. General professional certification directories have been published including Michael A. Pare's (editor) in 1966, and his second edition in 1999 (Pare, 1999). Another general professional certification directory was published in 1997, edited by Philip Barnhart (Barnhart, 1997). A third directory focused on Information Technology, *Computer and Network Professional's Certification Guide*, has been out of print since 1998 and was already dated when published (Christianson, 1998).

Due to the lack of research on professional certifications as well as the relative newness in technology education, this chapter begins with an evaluation of technology education on both a national and local level, contained in section 2.2. The evolution of professional certifications and computer-based testing is also addressed in the same section. Finally, very recent extant professional certification studies relative to the research question will be examined as they pertain to the three aspects of the problem. Section 2.3 contains a literature review of studies associated with postsecondary college technology student enrollment; section 2.4 contains a review of studies associated with certification value and student awareness; section 2.5 contains a review of studies of certifications integrated with secondary and postsecondary college technology programs. This chapter concludes with section 2.6 which summarizes the literature associated with the three aspects of the problem.

## **2.2 Parallel between Buffalo State College and National Technology Educational Trends**

Buffalo State College's technology curricula and national technology educational trends developed, were enhanced, and have matured along similar timelines. BSC is an ideal microcosm in which to study national technology educational trends, including the impact of professional certifications. Federal legislation has greatly impacted the evolution of BSC's technology programs even as it has echoed national general trends in education. To gain a fuller understanding of how the past has influenced present trends in technology education and professional certifications, the researcher believes it is appropriate to document both national milestones in technology education as well as the development of the specific Buffalo State College programs included within the scope of this study and their relationship to relevant professional certifications, as illustrated in Figure 8. This encapsulation represents the evolution of technology education at BSC from 1895 to the present, showing the need in Buffalo public schools and how that need was met by BSC beginning in 1910 (although limited Manual Training teacher training began at Buffalo State in 1906). As both the school and its technology program matured, several related technology programs were descendants of its initial Vocational Industrial Program. Professional certifications relate to each of these programs: state-mandated certifications were associated with the teaching programs while voluntary certifications are associated with the non-teaching technology programs. This evolution will be explained in greater detail in the remainder of this section.

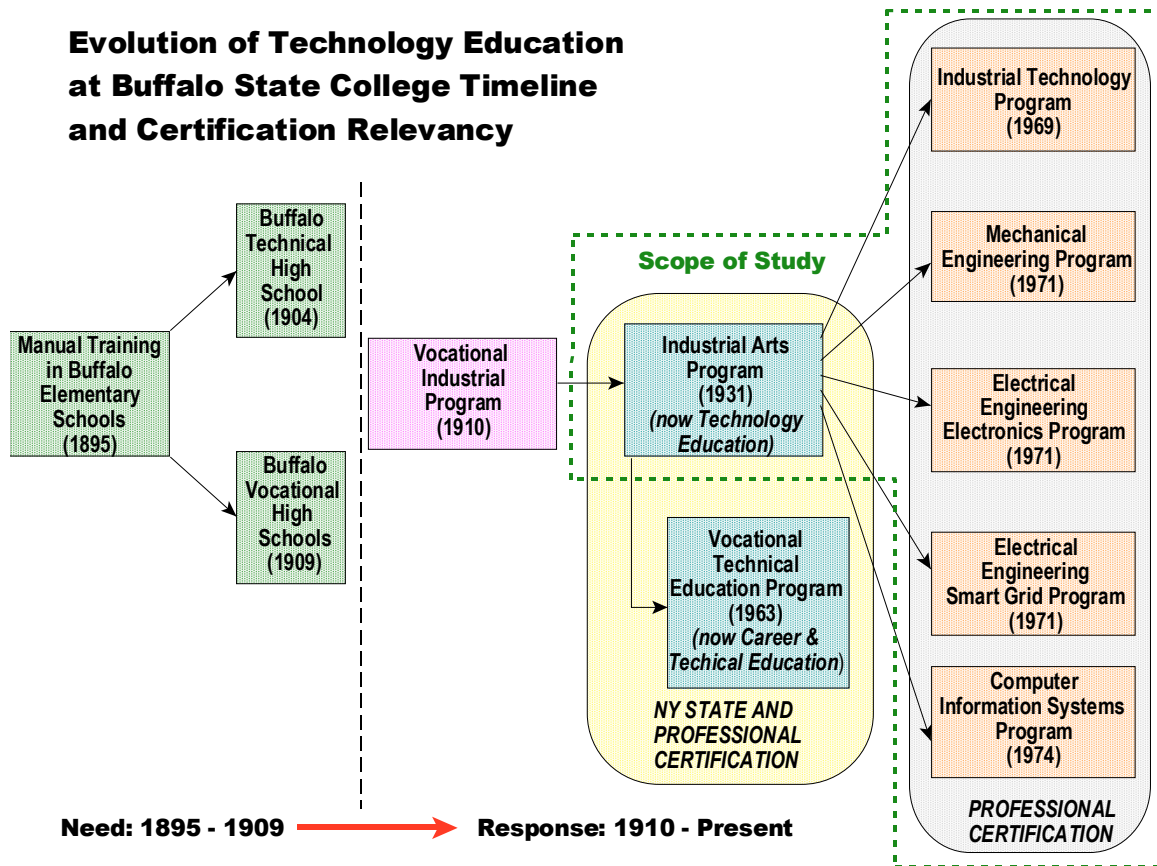


Figure 8. Evolution of technology education at Buffalo State College and relevant certification categories.

**2.2.1 Institutionalization of Industrial Arts education.** Formal secondary and postsecondary technology programs began with the Victorian-era Manual Training/applied learning movement that was the precursor to current Industrial Arts, technology, and vocational training programs. First used in the United States in the 1870s for the training of engineers, the applied learning movement spread rapidly to general public education of children in secondary and elementary schools. The need for technology education in American schools was a direct result of the dramatic impact of the industrial revolution on residents of the United States, Canada, and Europe. Following the Civil War, the American economy started a rapid shift to manufacturing from its agricultural base. As a result, citizens migrated from rural areas to densely

populated urban centers, emerging manufacturing and transportation hubs, such as Buffalo, New York.

With the migration from rural to urban center came a need for a shift in educational methods. In the centuries-old agricultural and craftsman system, farming skills were passed down from generation to generation by family members or apprenticeships. These models of knowledge transmission from one generation to the next became quickly obsolete by the industrial revolution which required a new technology literacy and knowledge the old educational systems were unable to provide. In 1886 Buffalo Public Schools superintendent James F. Crooker said “In an age of machinery and the multiplied division of labor, there is little opportunity for the average boy leaving school to obtain an apprenticeship to any of the productive crafts, such as was possible a few years ago” (Buffalo Department of Education, 1886, p. 42).

Parents, concerned for their children’s future, recognized the need for reading, writing, and arithmetic: the “three Rs.” The ability to read, write, and apply mathematics skills were essential for adaptation to the new economy. In addition to learning the three Rs, parents also felt it was important children be trained for vocational life. Industry demanded students have higher educational attainment so they were prepared for vocational life in industry after leaving school (Misner, 2003, p. 1).

Daniel Upton, who is closely associated with Buffalo’s Manual Training movement, said prior to the 1870s, Manual Training was “not necessary because at that time the social problem was not so complex and the revolution of industrial methods had not made it so possible to almost wipe out the individuality of the workingman” (Upton D. S., Manual Training; Buffalo's Future, 1903, p. 4).

The need for Manual and Industrial Training was particularly acute in Buffalo when it became an internationally important manufacturing and transportation hub in the late nineteenth century. In 1904 a businessman noted “Buffalo has become such a manufacturing center that the demand for skilled labor is increasing all the time and [Manual Training] gives boys who desire a technical training just the opportunity they need to fit them for an industrial career” (Mechanic Arts High School, 1904, p. 6).

**2.2.1.1 Development of Manual Training.** In response to societal demands for an improved educational system for children and adults to adapt to the changing industrial-based American economy, the Manual Training or Manual Arts educational movement emerged for elementary and secondary school students. Manual Training, sometimes referred to as “through the hand” education, emphasized intellectual and social development associated with the practical training of the hand and the eye. While in theory these concepts had a broad range of applicability, during the late nineteenth century, at least for children, the concept of Manual Training found its use limited to the teaching of wood and metal working. Despite these limitations, the foundational concept and applicability of Manual Training was much broader than its implementation and remains applicable to current technology education.

The conceptual value of Manual Training was underscored by educational reformer John Dewey when he stated it enabled a student:

to become conscious of his powers and through the variety of uses to which he can put them; and thus to become aware of their social values... The saw, hammer, and plane, the wood and clay, the needle and cloth, and the processes by which these are manipulated, are not ends in themselves; they are rather agencies through which the child may be initiated into the typical problems which require human effort, into the laws of human production and achievement, and into the methods by which man gains control of nature, and makes good his ideals” (Dewey, 1901, p. 198).

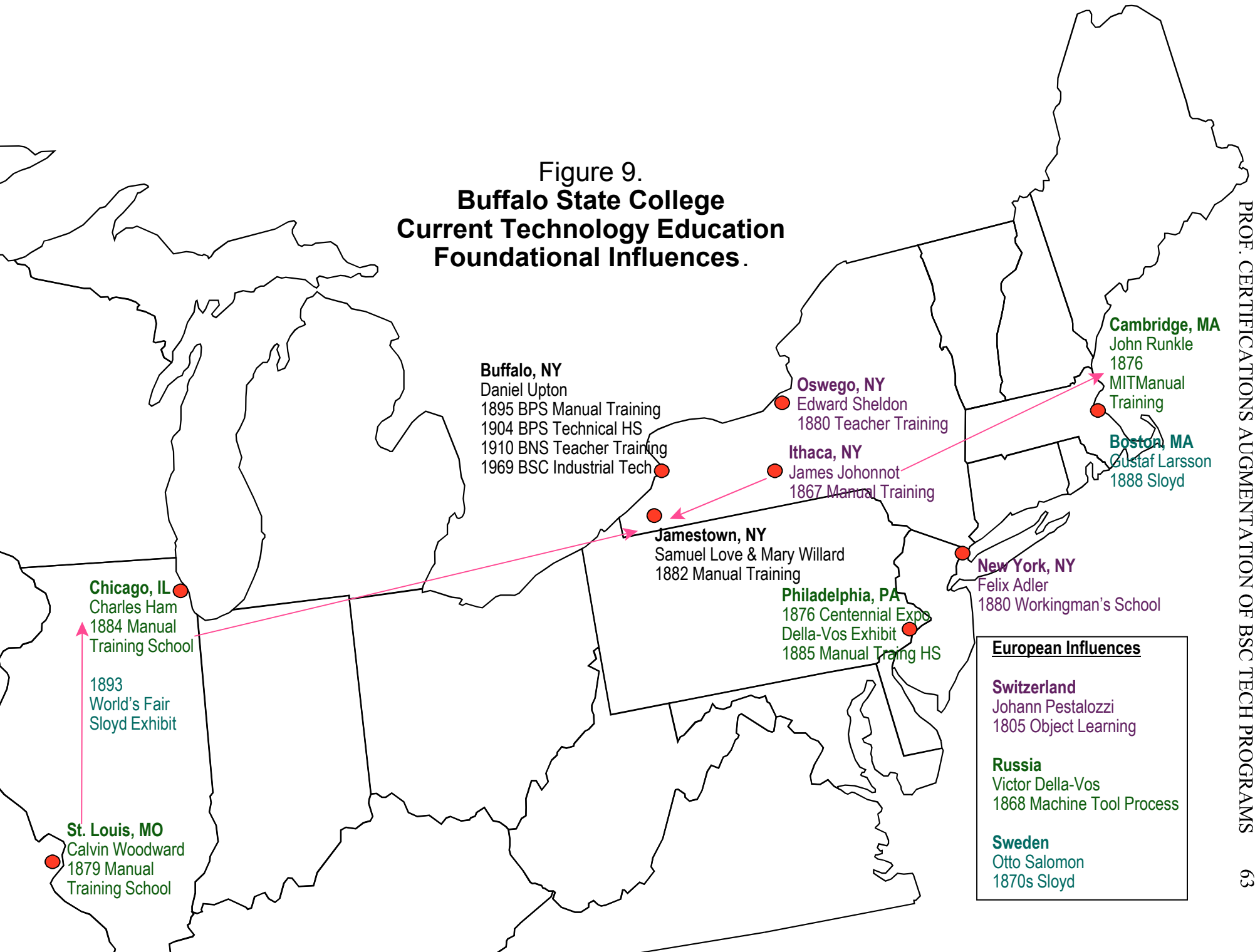


Diane Westerink, a Notre Dame University College of Engineering professor, contends despite limitations under which Manual Training classes were implemented in United States schools, the classes improved students' perception, observation, practical judgment, visual accuracy, and manual dexterity. Manual Training classes taught students the power of doing things instead of merely thinking about them, talking about them, or writing about them (Westerink, n.d., para. 2). Similar in concept to what would be called Industrial Arts during the twentieth century, Manual Training was not intended to teach a specific trade (in contrast to Vocational Training). Teaching a specific trade or discipline was perceived to be too narrow and intellectually limiting for a general education. Relating this observation to the contemporary problem being studied, these same objections are sometimes expressed when the idea of vendor-specific professional certification classes are proposed to be integrated within a traditional four-year technology education program. Rather than focusing on training students for a specific vocation, Manual Training was instead used as an augmentation to the traditional curriculum and perceived to help achieve a student's full potential. The student would learn to skillfully use tools in drafting, mechanics, wood or metal working and then transfer that knowledge to any type of academic setting.

Efforts to introduce the underlying concepts of Manual Training or applied learning into a postsecondary college curriculum in the United States date back to at least as far as the late eighteenth century with the establishment of colleges devoted to mechanics and agriculture. Manual Training programs were integrated into all educational levels and gained momentum in the United States in the late nineteenth century, but did not pervade all levels of elementary and secondary school curricula until

the early twentieth century. Manual Training and applied learning's origins have connections to Buffalo and Buffalo State College and are detailed throughout section 2.2.1.1.1 and illustrated in a map shown in Figure 9. The map appropriately shows Buffalo in its center. While Buffalo was not a leader in the very early evolution of technology education, there were several cities nearby, including those in New York State, which had important pioneering efforts that would impact technology education in Buffalo. In addition, arrows on the map indicate centers of influence between cities and leaders of those efforts. While the American efforts developed their own unique identity, most of the inspiration came from earlier work by European educators in three distinct schools of thought. The European work is color-coded and correlated to those American educators who were influenced by them. Figure 9 shows the early European and American pioneering efforts culminated in the creation of Manual Training, Industrial Arts, and Technology Education in Buffalo.

Figure 9.  
Buffalo State College  
Current Technology Education  
Foundational Influences.



*2.2.1.1.1 Foundations of Manual Training in the United States and in Buffalo.*

The origins of children's education in applied learning/Manual Training can be traced to Johann Heinrich Pestalozzi (1746 - 1827) who developed an object-teaching educational method that is referred to as applied learning today. Pestalozzi, a Swiss educator who is considered the "Father of Manual Training," operated a school in Yverdon, Switzerland beginning in 1805 that attracted the attention of American educators (Culver, 1986, p. 37). Pestalozzi developed instruction that emphasized sensory learning so that students formed clear concepts from sense impressions. Pestalozzi designed a series of graded object lessons, by which children examined minerals, plants, animals, and technology (human-made tools found in their environment). Following a graduated sequence, instruction moved from the simple to the complex, the easy to the difficult, and the concrete to the abstract. In short, Pestalozzi believed a sound education needed to include both an applied and theoretical education (Westerink, n.d., para. 4).

New York State was at the forefront of applied learning when Pestalozzi's concepts were popularized within New York and the rest of the United States by Dr. Edward Austin Sheldon (1823 - 1897), superintendent of schools for the City of Oswego and founder of the Oswego Primary Teachers' Training School in 1861. Oswego is located approximately 150 miles northeast of Buffalo on Lake Ontario in north-central New York. Based on Pestalozzi's object-teaching method, Sheldon incorporated lessons using objects, charts, illustrations, and more active learning methods instead of rote memorization. Sheldon's "Oswego Method," was soon known nationally and internationally (Nekritz, 2010, p. 41). Oswego's Primary Teachers' Training School was

incorporated within the New York State-operated teacher training school system, known as normal schools, as the Oswego State Normal School in 1866.

Sheldon, along with another famed New York State educator, Dr. Felix Adler (1851 – 1933), were instrumental in the evolution of Pestalozzi's object-teaching methods into Manual Training methods. In 1880, Adler implemented a Manual Training adaptation of object-teaching for elementary school children at his Workingman's School in New York City, a private, independent educational institution. Adler said: "The old object method was to teach the child to observe, which is better than to teach the names of things; but manual training teaches them not only to observe but to create" (Johonnot, 1898, pp. 173-174).

At the same time that Adler was adapting object-teaching to Manual Training methods for children, Sheldon was doing the same for teachers by creating an Industrial Arts/Manual Training program at Oswego. About 1880 a crude shop was created in Oswego Normal School's basement and operated by the school's janitor, Frederick H. Cyrenius (Bennett C. A., 1937, p. 464). In 1886-1887, Dr. Sheldon announced his intention of starting an Industrial Arts/Manual Training program at Oswego State Normal School. Oswego is the first institution in New York State to have a manual training course organized in a normal school or teacher training institution and among the earliest in the United States (Oswego State University of New York, 1941, p. 6). Because the Oswego program unofficially started in 1880, it is sometimes identified as the first in the nation, although another normal school, Bridgewater in Massachusetts offered a "manual training course" (although on an informal basis) in 1881 (Rogers, 1961, p. 32).

Although Sheldon announced the creation of an official Industrial Arts/Manual Training program in 1886-1887, it took several years to make it a reality. In 1888, the Honorable Stephen Mortimer Coon (1845 - 1913), New York State Assemblyman (1888 and 1889) and member of the local board of the Oswego Normal School, introduced a bill for the Industrial Training Act authorizing manual training instruction in the New York State public and normal schools (Rogers, 1961, p. 29). Coon's obituary noted he "was deeply interested in educational matters and recognized as an authority . . . throughout the State. He was also deeply interested in Manual Training and was one of the pioneers in preparing legislation which led to the establishment of manual training departments in the State schools" (S. Mortimer Coon, 1913).

Approved on May 19, 1888 by Governor David B. Hill, the law authorized "the establishment and maintenance of departments for industrial training and for teaching and illustrating the industrial or manual arts in the public schools and normal schools" of New York State. Through the Industrial Training Act, New York State school districts were empowered to levy additional taxes to build shops and hire industrial arts teachers. The normal schools were required to "include in their courses of instruction the principles underlying the manual or industrial arts, and also the practical training in the same" (Chapter 334, 1888, p. 589).

Despite the Industrial Training Act of 1888, it wasn't until 1893 that Oswego's Manual Training curriculum finally became formalized with the addition of new shops, equipment, and a technically trained teacher, Richard K. Piez, was hired (Bennett C. A., 1937, p. 470). Piez was a graduate of Baltimore Polytechnic Institute (Rogers, 1961, p. 29).

At nearly the same time Oswego's Manual Training curriculum was being formalized, another important educational development took place in New York. One of the goals of the Industrial Education Association, organized in New York City in 1884, was to provide training for Manual Training instructors in grammar and secondary schools. As a result, by the late 1880s, teacher's school was established in association with Columbia University, eventually called the Columbia Teacher's College. The program's prestige was aided by its own Macy Manual Arts Building. By the early 1890s the college offered Bachelor's, Master's, and Doctorate degrees in Manual Training. As such, it was the first educational institution in the United States to offer graduate degrees in Manual Training (Bennett C. A., 1937, p. 479).

As these other developments were occurring throughout New York State, applied learning advocate Daniel Upton instituted Manual Training in Buffalo. He agreed with the importance of object-teaching/applied learning educational methods when he said "In this age of the application of the sciences, success in life depends quite as frequently on an intelligent knowledge of things as of theories" (Upton D. S., Annual Report of the Director of Manual Training, 1897, p. 100).

*2.2.1.1.2 National leaders and institutions of applied education and Manual Training.* Another foundational aspect that occurred in the development of American Manual Training was the Morrill Act of 1862, sponsored by Congressman Justin Morrill (Whig, Republican 1855-67). A member of the Ways and Means Committee, he sponsored the Morrill Act of 1862, which provided public lands for secular technical colleges. During the Civil War, Morrill was concerned the United States needed to produce workers skilled in the trades, required for a nation growing quickly and starting a

transition from an agricultural to a manufacturing economy. The Act was set up to establish institutions in each state to educate citizens in (technology-assisted) agriculture, home economics, mechanical arts, and other professions (Parker, 1924, pp. 278-283). In New York State, Cornell University was founded under this system. The Massachusetts Institute of Technology, a school whose origins predate the Morrill Act, is considered a land grant college as it was formed when the Act was taking root. MIT would play an important and influential role in the development of Manual Training in America.

Outside of the United States, formal postsecondary programs that incorporated Manual Training/applied learning concepts were first instituted about 1867 at the Moscow Imperial Technical School by its director, Victor Karlovich Della-Vos (1/13/1829 – 7/15/1890). Although Della-Vos is credited with implementing applied learning concepts at the Technical School, it traces its origins to 1826 (today known as the Moscow State Technical University N.E. Bauman) (Schenck, *Manual Training Schools in America*, 1995, p. 5).

When Della-Vos was made the school's director in 1867, it was known as the Moscow Vocational School; within a year, it was renamed to the Moscow Imperial Technical School, reflecting the schools program change. Della-Vos' knowledge and passion for mechanics resulted in the development of a new hands-on education approach that taught students what they needed to know to become engineers and mechanics. His plans included both theoretical content and applied learning techniques in workshop and laboratory courses which were unique in their simplicity and detailed organization (Schenck, 1984, pp. 8-9). Della-Vos' education plan was like none other used in any other country and incorporated a graduated series of exercises or models based on an



analysis of tool processes (Rogers, 1961, p. 28). In the graduated system, the student would not progress to the next educational model until he mastered his current educational unit.

In the late 1870s, Della-Vos and the Moscow Imperial Technical School had a profound impact on American secondary and postsecondary technology education. In 1876, the United States celebrated its centennial anniversary. With its wounds healing from the Civil War, the nation's public officials were anxious to show the world its independence, history, and industrial progress under capitalism and democracy. The celebration was combined with an international exposition, the first world's fair to be held in the United States. The Exposition, which was held in 1876 from May 10 through November 10, was officially named the *International Exhibition of Arts, Manufactures and Products of the Soil and Mine*, although it was commonly known as the *Philadelphia Centennial Exposition*. Sixteen foreign countries planned to attend the event; the two largest exhibits were from England and Tsarist Russia. Della-Vos had prepared an impressive exhibit of accomplishments from the Moscow Imperial Technical School featuring machine tools made by the school's students (Schenck, *Manual Training Schools in America*, 1995, pp. 1-2).

The purpose of Della-Vos' display at the Exposition was to show the value of the joining between theoretical studies and their practical application. Of his display, Della-Vos said: "In the Imperial Technical School of Moscow, the course of theoretical subjects equals that of many of the polytechnical schools of Western Europe and combines theoretical with practical education; consequently it is enabled to present real proof of the possibility and advantageousness of such a combination, since the trial of

this combination has been made on an extensive scale and during a considerable length of time” (Della-Vos, 1937, p. 48).

In addition to the Russian exhibit, visitors to the Exposition had the opportunity to see many new technological wonders including the impressive specially-built Corliss Centennial Steam Engine that powered virtually all of the fair’s exhibits; Alexander Graham Bell’s telephone; the Remington Typographic Machine (typewriter); and the Wallace-Farmer Electric Dynamo, powering a system of arc lights that inspired Edison to further research. Among the estimated ten million visitors to the Exposition (twenty percent of the U.S. population at the time), were two influential educators: John Daniel Runkle (1822 - 1902), a professor of mathematics and president of the Massachusetts Institute of Technology (MIT) and Dr. Calvin Milton Woodward (1837 – 1915), dean of the Polytechnic faculty at Washington University in St. Louis, Missouri. Runkle and Woodward independently visited and were greatly impacted by Della-Vos’ exhibit. Prior to Della-Vos’ influence in the United States, engineering schools did not teach hands-on skills; students were expected to obtain experience on their own (Schenck, *The Life and Times of Victor Karlovich Della-Vos*, 1984, pp. 21-22).

Runkle, with a contingency of 370 faculty and students, visited the Centennial Exposition from June 8 to June 23, 1876. In a report made to MIT on July 19, Runkle noted “technological education is still in the experimental state.” Since the Civil War, according to Runkle, the two most important programs in America’s interest were agriculture and the mechanic arts. Runkle posed a question: “Can a system of shop-work instruction be devised of sufficient range and quality, which will not consume more time than ought to be spared from the indispensable studies?” To answer his own question,

Runkle replied, “This question has been answered triumphantly in the affirmative, and the answer comes from Russia” (Runkle, 1876, p. 5). Indeed, Runkle was greatly impressed by Della-Vos’ accomplishments at the Imperial Technical School.

In a speech about the system of technical education in Russia, Runkle said, “Based on the ideas that we got from Russia, it is becoming clear what the goals of our college should be; we must immediately expand and improve engineering courses by building workshops, which I feel is my duty to recommend.” On August 17, 1876 MIT authorized the establishment of shops and shortly thereafter, a dedicated building was constructed which housed workshops so that Della-Vos’ ideas introduced at the Exposition could be put to use in America (Schenck, *The Life and Times of Victor Karlovich Della-Vos*, 1984, pp. 21-22). In 1882 Runkle wrote and published *The Manual Element of Education*, a book that discussed his views and interpretations of the importance of Manual Training in education. Because Runkle did so much to popularize Manual Training in America, he sometimes referred to as the “Father of Manual Training in the United States” (Schenck, *Manual Training Schools in America*, 1995, p. 2).

In addition to having an influence on colleges, the Russian method began to impact U.S. secondary curricula as well, influenced by expanding American industrialization (Talbot, 1973, p. 9). In the late-nineteenth century, secondary schools were still a rarity and most American children did not attend them. The first Manual Training high school in the United States was founded in 1879 and opened in 1880 by Washington University in St. Louis (Lewis Jr., 1982, p. 107). Headed by Woodward and called the St. Louis Manual Training School for Boys, the curriculum was based on Woodward’s studies of the Russian system of tool instruction and included science,

mathematics, language, literature, history, drawing, and workshop. Workshop classes, simply referred to as “shop,” were included to keep instruction more interesting, to provide learning in the use of basic tools common to a variety of jobs and to increase general education. Woodward felt Manual Training was essential for proper intellectual and moral education and was a way of restoring the value and dignity of hand labor in the face of increased industrialization.

*2.2.1.1.3 Manual Training and the Arts and Crafts movement.* The aspect of incorporating hand labor in Manual Training may seem at odds with a curriculum rooted in a manufacturing-based society. Indeed, evidence to support this assertion can be observed in the Arts and Crafts movement popular in Great Britain and the United States during the late-nineteenth century. Popularized by William Morris, and based on earlier writings by John Ruskin, the Arts and Crafts movement appeared to be anti-technology. The movement included rebellion against the aesthetically numbing and socially debasing effects of the Industrial Revolution. As the Arts and Crafts movement migrated from England to the United States, its boundaries were tempered against the reality of its economic impact. The British movement focused on medieval themes performed only by craftsmen. Their products were very costly and thus the movement was limited to Britain’s upper class. In contrast, the American Arts and Crafts movement focused on the purity of materials used, rather than processes. The American Arts and Crafts movement included the use of machines to lower product cost but allowed craftsman to perform the assembly and finishing processes (Garni, 2003, p. 4).

While Woodward had founded a specialized, private secondary school for Manual Training, he nonetheless advocated for the inclusion of Manual Training into traditional

secondary and primary public school curricula to bring education in accordance with the demands of modern society. Woodward's believed Manual Training would help students realize at any early age the connection between knowing and doing was spread through two nationally-influential volumes he authored: *The Manual Training School* in 1887 and *Manual Training in Education* in 1890. In these works, Woodward reported his methods and ideology in the instruction of students using practical hands-on applications. Woodward, like Runkle, is sometimes referred to as the "Father of Manual Training in the United States" (Miller, 1963, p. 20).

#### *2.2.1.1.4 Samuel G. Love and pioneering Manual Training efforts in Jamestown.*

Contemporaneously with the opening of Woodward's St. Louis Manual Training School, a public school district formally inaugurated a comprehensive and integrated Manual Training program just 75 miles southwest of Buffalo. In 1882, a Manual Training shop was built at Jamestown, New York by its superintendent of schools, Samuel Gurley Love (1821 - 1893), an enthusiastic proponent of Manual Training. Love was born on May 30, 1821 in Barre, New York and graduated from Hamilton College in 1841 with a Bachelor of Arts degree (Doty, 1940, p. 723). He subsequently studied law but instead decided to pursue a profession in teaching. Early in Love's educational career, he taught at Buffalo's School No. 15 at 518 Oak Street during the mid-to-late 1840s (1847-1848 Commercial Advertiser Director for the City of Buffalo, 1847, p. 95). In 1850, Love became the first principal of the Randolph Academy and Female Seminary (later called the Chamberlain Institute). Love was principal of the Academy from 1850 to 1853 and again from 1859 until 1864 (Ellis & Nash, 1879, p. 199). During Love's second term as principal of Randolph, he was also a Major in the 154th New York Infantry during the

Civil War. He enlisted for three years, but served from September 24, 1862 until November 23, 1862 (Phisterer, 1912, pp. 3792, 3801).

In 1865, Love became principal of the Jamestown Union School and Collegiate Institute and the first superintendent of the Jamestown public schools. Love remained principal of the academic department until 1881 and superintendent of all its public schools until 1890 (McMahon, 1958, p. 207). His quarter-century tenure allowed Love the opportunity to implement innovative and advanced public school educational endeavors including gymnastics, music, and Manual Training. An image of Love is shown in Figure 10.



**Figure 10.** Prof. Samuel G. Love implemented the first comprehensive public school Manual Training Program in the U.S. at Jamestown. *Historic Annals of Southwestern New York.*

Jamestown, located in Chautauqua County, was in the nineteenth century a growing town renowned for its furniture manufacturers. Its population doubled from

5,336 in 1870 to 9,357 in 1880 (Downs, 1921, p. 167). In 1874, two years before the Philadelphia Centennial Exposition, Love began to introduce Manual Training methods at Jamestown. Love's efforts are recognized as being the first comprehensive Manual Training curriculum integrated into a public school system in the United States (Johonnot, 1898, p. 169). While it is unknown whether Love was directly influenced by Woodward or Runkle, it is known he was indirectly influenced by their efforts. Love was influenced by the writings of Charles Henry Ham of the Chicago Manual Training School, the first independent secondary Manual Training school in the United States, opened in 1884 (Love, 1887, pp. 1-2). Ham was previously influenced by the work of Woodward's St. Louis Manual Training School (Ham, 1886, p. iv). While several cities in the United States had dedicated Manual Training or technical high schools by the early twentieth century, the two most renowned were those in St. Louis and Chicago (Schenck, *Manual Training Schools in America*, 1995, p. 8).

While Love may have been directly or indirectly influenced by national Manual Training luminaries during the late 1870s and early 1880s, his efforts predate theirs, including Della-Vos' exhibit at the Philadelphia Exposition. Love's idea to create a Manual Training program in Jamestown's public schools can be traced to Ithaca-based educator and author James Jhonnot (1823 – 1888) during a series of meetings he had with Love between 1867 and 1869. Jhonnot was an advocate of both Manual Training and Pestalozzi's object-teaching methods. He found a ready audience for his ideas in both Love and Runkle. Jhonnot was lifelong friends with both educators and encouraged their efforts to initiate Manual Training programs (Jhonnot, 1898, pp. v, xi). Because of Love and Runkle's early successes, Jhonnot, as president of the New York

State Teachers' Association, made Manual Training the subject of every paper read at the organization's 1880 annual meeting held in Canandaigua (Johonnot, 1898, p. 172).

Because of Johonnot's influence, Love began to publicly advocate for Manual Training in Jamestown's public schools in 1871 (McMahon, 1958, p. 206). Yet, it wasn't until the autumn of 1874 when Love had the opportunity to implement the integration of Manual Training (which Love referred to as industrial education) into a public school curriculum with the creation of a print shop where boys and girls printed material for the Jamestown Board of Education (Love, 1887, pp. 21-22). The program grew slowly for several years thereafter with the children collecting various wood species; engaging in the construction of penwipers and scrapbooks; as well as participating in sewing and workbench classes (McMahon, 1958, p. 208).

By 1880, Love's Manual Training effort was implemented at Jamestown on a limited basis and a full-fledged industrial department for boys was created on January 2, 1882 (Wilber, 1949, p. 8). Manual Training in the Jamestown high school was introduced in 1884 (Johonnot, 1898, p. 171). With the efficient help of Love's teaching staff Mary Rosina Willard (1874 – 1931) and Elizabeth H. McElory, Manual Training was provided for all grades of Jamestown's students (Wilber, 1949, pp. 1-17). By 1887, all the children in Jamestown's first six grades, about 1,400 in all, were given from three to five lessons in Manual Training each week. As might be expected, there was a division of Manual Training subjects based on gender. In the upper grades and high school, Manual Training classes were held two or three times each week. Girls were taught sewing, knitting, crocheting and cooking, while boys were taught woodworking.



Yet there were subjects common to both genders: boys and girls set type in the print shop for one hour, four days each week in addition to studying penmanship and drawing.

During the mid-1880s, Professor Love and his teachers spread the results of their successful educational initiatives to nearby school administrators through lectures and writings. As a result, the Manual Training work at Jamestown attracted wide attention among educators, and Love was influential in the introduction of Manual Training/industrial education to other school districts throughout New York and the United States (Doty, 1940, p. 725).

Love's ability to influence other educators on the merits of Manual Training was aided by his exceptional oratory skills. At the 1874 meeting of the New York State Teachers' Association where he was a speaker, it was noted "Professor Love's elocution is perhaps the most nearly perfect of any of the speakers. His style is exceedingly fine and attractive" (Educators in Council, 1874).

In 1886 at the twenty-fourth Convocation of the New York State University, Love had the opportunity to share his work with a nationally influential audience. At the convocation, Love was a featured speaker and read his paper, *Manual Training*. Other prominent speakers the event included James McCosh, president of Princeton, and Charles Kendall Adams, president of Cornell University (The University Convocation, 1886, p. 4).

During the course of his outreach, Love was encouraged to write a course of industrial education instruction to reach a wider audience. Love, assisted by Willard, wrote and published *Industrial Education, A Guide to Manual Training* in 1887 (Bennett C. A., 1937, pp. 422-423). This influential volume was the first complete Manual

Training textbook ever produced in the United States (Clary, 1907, p. 11). It is difficult to overestimate the educational importance of Love's book. In an 1887 review, it was noted:

A more timely book has barely been set forth. Industrial education, whether or not in connection with the common schools, is deservedly attracting attention, and is making strides to the front. The demand every year for education in the useful arts increases with the population. Boys and girls have been thrown on the world, after acquiring what is popularly known as "education." Then the world has asked them, "what can you do?" In many cases the answer has not been forthcoming (Literary Matters, 1887).

While Love's work has earned him a prominent place in America's integration of industrial education into public schools, the reception of *Industrial Education, A Guide to Manual Training* was positively impacted by publicity he received as a result of a high-profile marriage scandal. The saga began on June 20, 1846 when Love married Mary Fenn Robinson (1824 – 1886) at Clarendon New York, where Robinson was born. Robinson, who achieved fame through her efforts in the suffrage, temperance, and Spiritualist movements, was intelligent and highly educated. She attended the famous Ingham University in LeRoy New York, the state's first women's college. She graduated in 1846, just prior to her marriage to Love. The Loves had two children: Frances Eliza "Fanny" (born 1847) and Charles G. (born 1849). The Loves' marriage changed drastically after they moved to Randolph. There, Mary developed a great interest in the emerging Spiritualism and the women's rights movements. In 1853, Robinson along with Susan B. Anthony, Frederick Douglass, and Elizabeth Cady Stanton (and others) organized the first New York State Women's Rights Convention. At the convention Robinson was elected a vice-president (Woman's Rights Convention, 1853).

Initially, Love appeared to share Robinson's interests. Those who were socially conscious during the decade of the 1850s often had in common interests in abolition, temperance, women's rights and Spiritualism (Braude, 2001, pp. 56-81). With Robinson, Love also participated in the first two New York State Women's Rights Conventions, held in 1853 in Rochester and 1854 in Albany (Women's Rights Convention at Albany: Evening Session, 1854, p. 6). Love also participated in Spiritualism, and some of his activities are relevant to this study.

Love's connections to Spiritualism included John Murray Spear (1804 - 1887), a Boston Universalist minister and abolitionist. In 1851 Spear became a Spiritualist and two years later he believed he was the chosen medium for the Association of Beneficents, comprised of distinguished, albeit departed, men including Thomas Jefferson, Benjamin Franklin, and Benjamin Rush, among others who wished to extend their benevolence to their mortal friends (Spear, *Twenty Years on the Wing*, 1873, p. 16).

Meanwhile, in approximately 1850, the wife and daughters of Chautauqua County blacksmith John Chase received messages from spirits who informed them the land bordering Kiantone Creek, near the town of Carroll, was inhabited a thousand years earlier by a perfect society of Celtic Indians (A Spiritualist Convention in Chautauque, 1858, p. 6). The source of their strength was two magnetic springs (one with positive energy and one with negative energy) imbued with special healing properties. The springs were located on the bank of Kiantone Creek, at the foot of a high bluff at the forest's edge, within the boundaries of a farm owned by Chase and his brother Oliver G. Chase (Randolph man played large role in formation of Spiritualist utopia, 1971, p. 3).

In the summer of 1852 Chase, accompanied by his neighbor William W. Brittingham (a physician and Spiritualist), excavated Chase's farm and discovered the long-lost springs. In late 1852 wealthy Randolph resident and Spiritualist Thaddeus S. Sheldon (1818 – 1868) promoted the supposed healing properties of the Kiantone spring water during a visit to New York City where he gave samples to Dr. James P. Greaves of Milwaukee and to Spear who resided in the Boston area (Lehman, 1973, p. 160). In January 1853 an article that Greaves wrote about Kiantone's springs was published in the periodical *Spiritual Telegram* and attracted wide attention (Lehman, 1973, p. 155).

During the spring and summer of 1853, Spear visited Western New York and Northeastern Ohio. The area was famous for its ties to Spiritualism, principally because of the dramatic séances conducted by Kate and Margaret Fox, sisters who lived in Hydesville near Rochester. On April 14, Spear visited Kiantone with a small group of Spiritualists who spent a few days at the springs, by then known as the Magnetic or Spiritual Springs (Buescher, *The Remarkable Life of John Murray Spear*, 2006, p. 89). From Kiantone, Spear traveled to Cleveland on May 5 where he gave a series of lectures to its growing and influential Spiritualist community. On May 10, Spear returned to Kiantone, this time accompanied by a contingency of wealthy Cleveland Spiritualists. Spear convinced his Cleveland benefactors (including Horace Fenton and Abel Underhill) to purchase approximately 170 acres of land bordering Kiantone Creek, adjacent to Chase Farm. Spear called the settlement Harmonia on the Domain (McCabe, 1920, p. 84). Spear's intention was to control the mystical healing springs and to distribute its water free of charge to anyone who requested it, although postage and handling fees were not included (Lehman, 1973, p. 163). By June 1853 pilgrims to

Spiritual Springs were so numerous that John Chase and Brittingham built a hotel on their farm for visitors (The Spiritual Springs Near Carrol, 1853, p. 6).

After making the purchase of Harmonia at Kiantone, Spear next journeyed to Niagara Falls and visited its Hydraulic Canal, which was under construction at the time. Built by the Niagara Falls Hydraulic Company, the canal was intended to support manufacturing, chemical, and mechanical businesses by powering associated machinery through the perpetual motion of water power drawn from the Niagara River at a source immediately above the falls (Buescher, The Remarkable Life of John Murray Spear, 2006, p. 91). From Niagara Falls, Spear travelled to Rochester in order to visit the noted Spiritualist Rev. Charles C. Hammond. During a trance session with Hammond held on June 30, six spiritual associations (in addition to the Beneficents), were revealed to Spear. These included the Association of Electricizers, an organization of approximately six technologically-minded spirits led by Benjamin Franklin (Spear, Twenty Years on the Wing, 1873, p. 23). While Spear claimed to have had his first spiritual communication from Benjamin Franklin in November 1852, it wasn't until July 22, 1853 that Franklin's role as a "leading member" of the Electricizers was revealed to Spear. Surprisingly, instead of Spear, the Electricizers named Sheldon as their agent, to "execute and complete their schemes" (Spear, The Educator:, 1857, p. 141).

The Electricizers' initial effort, or scheme, was the development of new technology: a perpetual motion machine called "New Motive Power," a mechanical Messiah hoped to be the technological salvation of humanity. The motor was envisioned to revolutionize industry and enable Harmonia's residents to work four hours each day, producing wealth for all (McCabe, 1920, p. 84).

During the summer of 1853 when Spear was in Chautauqua County, he had the opportunity to become acquainted with Love, likely through his association with Sheldon, a founder and Secretary of Randolph Academy (Ellis & Nash, 1879, p. 196). Through Spear's or Sheldon's discussion about New Motive Power, Love became one of the few individuals sufficiently interested in it and who was willing to aid in its undertaking (Spear, *The Educator*, 1857, p. 239). Twenty years later, Love was remembered by Spear as one who "greatly assisted" him in the construction of the machine (Spear, *Twenty Years on the Wing*, 1873, p. 27).

The New Motive Power motor was designed to harness magnetic energy and electric life currents emanating from the universe. During the nineteenth century, some scientists attempted to develop a perpetual motion machine that could work indefinitely without a traditional energy source, even though such a machine would violate currently understood laws of physics and thermodynamics. Spear's critics called the machine a swindle and ridiculed it with "course and ribald" remarks in the press (McCabe, 1920, p. 85).

Despite such criticism, in July 1853 construction on New Motive Power began by Spear and a handful of his followers in the woodshed of the Hutchinson family's cottage at High Rock, a hill with an elevation of 170 feet (believed to have connections to the spirit world) located in Lynn Massachusetts, outside of Boston. Completed in the spring of 1854, Spear's supporters attempted to set the machine in motion by sitting around it and placing their hands on it to show their religious reverence for technology. While the machine was a technical failure, Spear and his followers believed the Electricizers' spirit

wisdom had brought the human race to the threshold of a new technological millennium (Carroll, 1997, pp. 105-107).

In July 1854, Spear brought the New Motive Power machine to Harmonia, hoping the Magnetic Springs would allow the machine to operate properly (Spear, *The Educator*., 1857, p. 251). New Motive Power was stored in Sheldon's barn but before it could be fully installed, according to Spear, in August a "rude mob" of young men from Randolph broke into the barn and destroyed the machine (Randolph man played large role in formation of Spiritualist utopia, 1971, p. 3). Spear proclaimed that the destruction of New Motive Power led the Electricizers to conclude humanity was not yet ready for their technological revelations and the spirits forbade Spear to reconstruct the motor (McCabe, 1920, p. 85). However, Spear left a window of hope open when he said the principles learned during the machine's construction were preserved for use at an appropriate future time (Spear, *Twenty Years on the Wing*, 1873, p. 27).

Despite the loss of the New Motive Power perpetual motion machine at the hands of Chautauqua County residents, Spear's interest in the Spiritual Springs grew. In autumn 1854 Spear claimed the Association of Beneficents gave their endorsement for Spear and some of his followers to permanently relocated to Harmonia and recreate its utopian community (Deveney, 1997, p. 16).

At the same time these dramatic events took place in Lynn and Kiantone, Robinson continued her pursuit of Spiritualism. In early 1854 she met the influential and charismatic Spiritualist mesmerist Andrew Jackson Davis (1826 – 1910), also known as the Poughkeepsie Seer. The occasion for the meeting was a trip to Rochester Robinson and Love made to attend a series of lectures Davis, with the assistance of spirit guidance,

gave on medical subjects. It was there Robinson fell in love with Davis, and she wrote him a long letter describing the “great disaffection” between herself and Love (Andrew Jackson Davis, 1885). It was no surprise that Robinson and Love should seek out Davis as Spear had been influenced by Davis’ 1847 volume, *The principles of nature, her divine revelations, and a voice to mankind*, during the late 1840s and early 1850s (Carroll, 1997, p. 105). Robinson met Davis just two more times before she decided to take steps to engage in a relationship with him (Why He Got a Divorce, 1885, p. 1). Robinson and Love separated in Cleveland on May 30, 1854 and Robinson then traveled to Indiana where liberal laws allowed her to obtain a divorce from Love (Braude, 2001, p. 117). Robinson began divorce proceedings on August 12, 1854 and the divorce was finalized on September 26 (Buescher, Andrew Jackson Davis and His Wives, n.d., Mary Fenn Robinson section, para. 2). In addition to the scandal caused by the divorce, Robinson lost custody of her two children to Love. Robinson returned to Clarendon to live with her parents until she and Davis were married there on May 15, 1855 (Mr. Davis Gets a Divorce. Tangled Matrimonial Affairs of a Philosopher., 1885, p. 5). When Davis arrived at Clarendon, he said to Robinson: “Mary this visit is necessary for you to become acquainted with me. Personally we are almost total strangers to each other. And yet you are no stranger to my spirit, for I have seen you through the distance many times” (Andrew Jackson Davis, 1885).

According to the prevailing morals of Victorian society, Robinson’s actions were viewed as child abandonment. The price of Robinson’s divorce was the loss of her children, although she did regain their custody in 1865 (Mrs. Mary Fenn, 1886). Davis and Robinson liaison was universally condemned and newspapers at the time said of the



affair “Spiritualism . . . removes the barriers to licentiousness and vice, as exemplified in the conduct of Andrew Jackson Davis, who is now living an adulterous life in the city of Brooklyn with the wife of Mr. Love of Buffalo” (Andrew Jackson Davis, 1885).

During his marriage turmoil, Love left Randolph and returned to Buffalo where he lived from 1854 until 1859. During this period, Love served as principal of Buffalo’s School No. 6 at 240 South Division Street near Chestnut Street. Love subsequently met a music teacher, Louise Metcalf, whom he intended to marry. Metcalf was the oldest daughter of Baptist Rev. Whitman Metcalf of Nunda (Death of Professor Samuel G. Love, 1893).

However, Love’s marriage plans were stymied when he discovered that the divorce granted to Robinson in Indiana was not legal in New York State. At the time, New York only allowed divorce on the grounds of adultery. Ironically, Robinson’s actions with Davis gave Love the legal basis for divorce in New York. On May 24, 1856 the New York State Supreme Court in Erie County granted Love an absolute divorce from Robinson on the grounds of her adultery. The terms of Love’s divorce would prove to be harmful to Robinson. The divorce stipulated it was lawful for Love to marry again, but it would not be lawful for Robinson to marry again while Love will still alive. Consequently, Robinson and Davis’ marriage was not legal in New York State, but Love was free to marry Metcalf. They were wed on July 30, 1857 (Buescher, Andrew Jackson Davis and His Wives, n.d., Mary Fenn Robinson section, para. 6).

Despite the illegality of Robinson and Davis’ marriage in New York, they continued to live together as a married couple and moved to Orange, New Jersey. Robinson and Davis’ fame grew in the Spiritualism community through their lectures and

writings. For example, at the Seventh National Woman's Rights Convention at the Broadway Tabernacle in New York City during November 1856, Robinson shared the stage with Susan B. Anthony as featured speakers. Ironically, one of the topics explored at the convention was "Marriage as it is – a curse" (Seventh Annual National Woman's Rights Convention, 1856, p. 1). Through speaking engagements such as these, Robinson achieved national prominence in the suffrage and temperance movements, and continued to count Susan B. Anthony and Elizabeth Cady Stanton "among her dearest friends" (Mrs. Mary Fenn, 1886). Meanwhile, in the ensuing decades, Love's fame grew because of his innovative educational methods.

By the 1880s, these marital events of the 1850s would have been long forgotten if it was not for Davis. When Robinson and Davis were married in 1855, he declared the spirits had pronounced theirs a spiritually perfect union. However, in 1885, Davis announced the spirits were misinformed: their union did not have proper harmony and his true affinity was with a woman who was fifteen years younger than Robinson, a fellow student of Davis' (Edgerly, 1990, p. 203). As a result, Davis made attempts to eradicate his marriage to Robinson. During Davis' attempts to do so, he told the New York Supreme Court that he remained married to Robinson only for "business relations," which was reported in sensational accounts by New York City newspapers (His Wife for Business Only, 1885, p. 1). Davis and Robinson's marriage was fully annulled on January 31, 1885 and Davis wed his new bride on August 11, 1885. Robinson was distraught because of Davis' new marriage and her health quickly deteriorated; she died in July 1886 (Mrs. Mary Fenn, 1886). As a result of Davis' actions and Robinson's subsequent death, the heady brew of Spiritualism, divorce, child abandonment, Robinson

being abandoned for a younger woman, and bigamy played out in the newspapers across the United States during 1885 and 1886. Love appeared to be an innocent victim in the proceedings and by the time his book on Industrial Education was published in 1887, his name was already a household word.

Love's book *Industrial Education, A Guide to Manual Training* solidified his pioneering reputation in the field of industrial education on a national level. Some of the accolades Love received for creating an outstanding program of Industrial-Manual Training were documented in the following: *Report of the Industrial Education Commission* to the Pennsylvania State Legislature in 1891; *Art and Education, Volume II*, edited by the United States Bureau of Education in 1892; and the *Eighth Annual Report* of the United States Commissioner of Labor in 1892 (Doty, 1940, p. 724).

Love passed away on November 12, 1893 and is memorialized in the Samuel G. Love Elementary School in Jamestown, New York. In Love's obituary, it was noted Love's industrial education initiative was "discussed in all parts of the United States and it has been adopted in countless schools. Had he accomplished nothing else, the successful issue of his thought and labors in establishing industrial education would entitle him to lasting fame and gratitude" (Samuel G. Love, 1893).

#### *2.2.1.1.5 The influence of Swedish sloyd on American Manual Training methods.*

Just as Love's book was impacting a national audience, a new international influence on American Manual Training efforts would be felt at another world's fair held in the United States, nearly two decades after the Philadelphia Exposition. This time, the influence would come from Sweden instead of Russia. While Manual Training efforts had begun in the United States by the early 1880s, its results would be expanded and reinforced by the

introduction of the Swedish sloyd, or handwork method. As an educational method sloyd was promoted by Otto Aron Salomon (1849 - 1907) beginning in the 1870s in a school for teachers he founded in Nääs. Sloyd was introduced to American audiences in Boston's public schools by Salomon's student Gustaf Larsson in 1888 (Bennett C. A., 1937, p. 431). Larsson's Boston sloyd curriculum was exhibited at the 1893 World's Columbian Exposition in Chicago and attracted attention from educators throughout the United States who sought to implement the techniques in their local districts (Eyestone, 1992, p. 28).

The result of the national American introduction of the Russian system in the late 1870s and Swedish system in the 1890s was the rapid national development of Manual Training curricula synthesizing the Russian and Swedish methods. Elementary and secondary school programs in particular were influenced by the Swedish sloyd system which stressed the development of useful articles in contrast to the Russian system which had no concern for useful projects (Cochran, 1970, p. 5).

As Manual Training was widely implemented in elementary schools by 1900, about 100 cities provided Manual Training classes in high schools. As a result, there was less a need for dedicated Manual Training high schools. As an example, in 1915 when Woodward's Manual Training School closed, the St. Louis public schools accepted the responsibility for Manual Training.

At the dawn of the twentieth century, Manual Training was firmly entrenched in the American educational system and it was widely accepted there were direct benefits associated with the integration of applied learning into a traditional liberal education. In

the years following, Manual Training evolved and three different paths of Manual Training evolved from disparate origins:

1. the concept of object (applied) learning founded by Pestalozzi;
2. tool instruction as founded by Runkle and Woodward; and
3. cultural education of which modern technology education is based (Foster P. N., *The Founders of Industrial Arts in the U.S.*, 1995, Context section).

Despite the propagation of Manual Training in public schools, shortly after the beginning of the twentieth century there remained a shortage of trained workers needed by the rapidly expanding industrial American landscape. Consequently, some leaders in Manual Training promoted its vocational benefits, although it was contrary to some of its basic tenants of Manual Training which did not focus on specific workforce development training. This need by American industry led to a bifurcation in Manual Training educational curricula: one aspect was trade-specific Vocational Education and the other was a general technical education that would soon be known as Industrial Arts (Schenck, *Manual Training Schools in America*, 1995, p. 17). Both aspects of the evolution of Manual Training during the twentieth century would be acutely felt in Buffalo and its Normal school.

***2.2.1.2 Manual Training changes its name in the twentieth century.*** As Manual Training entered the twentieth century, its non-vocational aspect was renamed “Industrial Arts,” first suggested in 1904 by Charles Russell Richards (1865 – 1936) of Teachers College, Columbia University (Richards, 1904, pp. 32-33).

On a national level, Industrial Arts education received a boost in 1906 from Massachusetts Governor William L. Douglas who created the Douglas Commission to

determine how education could be reformed to better prepare the Massachusetts workforce. The influential commission recommended increased industrial education opportunities, which paved the way for industrial education programs in Massachusetts' public schools and nationally (Davis, 2003, U.S. Education in the 1900s section).

Over the next twenty years, Manual Training programs within American public schools were renamed Industrial Arts, its evolution solidified by the seminal treatise published in 1923, *Industrial Arts for the Elementary School* (Bonser & Mossman, 1923). Bonser and Mossman redirected Industrial Arts away from activities and studies based on discrete materials or selected trade skills and toward broader conceptualizations, further differentiating and distinguishing Industrial Arts from Vocational Education. Bonser and Mossman defined Industrial Arts as the “study of the changes made by man in the forms of materials to increase their values, and of the problems of life related to these changes” (Bonser & Mossman, 1923, p. 5).

Industrial Arts began to be described as educational programs focused on the technology of manufacturing, communications, construction and power. Even though the program was designed to teach general knowledge about technology, specific classes taught the fabrication of objects in wood and/or metal using a variety of hand, power, or machine tools, and usually included technical drawing. Most Industrial Arts classes also included shop classes. There was some confusion in this area, as often shop classes were more closely associated with narrowly-focused Vocational Education, rather than Industrial Arts (Foster P. N., Technology Education: AKA Industrial Arts, 1994, p. 15).

By the 1970s, as the curriculum continued to adapt and evolve, the term Industrial Arts gave way to Technology Education (DeVore & Lauda, 1976, p. 137). Technology

Education focused on the study of technology, which provided an opportunity for students to learn about the processes and knowledge related to technology.

Technology Education allowed students to explore a variety of activities related to many areas where STEM intersects with society. Students developed problem solving strategies and work habits useful in almost any career and or occupation. The next section, 2.2.2, continues with the creation of technology education at Buffalo State College and how it was impacted by New York State and federal legislation. An overview of key dates is encapsulated in Table 1.

### 2.2.2 Industrial Arts education at Buffalo State College.

**Table 1. Timeline of National and Local Milestones Impacting Buffalo State College Technology Programs.**

<b>Year</b>	<b>National or Local Milestone</b>	<b>Impact</b>
1862	Morrill Land-Grant Colleges Act of 1862 (Parker, 1924).	Provides public lands for agricultural colleges where the “needful science for the practical avocations of life shall be taught.”
1867	Buffalo Normal School chartered through a special act of NYS legislature (Wofford, 1946).	Creation of Buffalo Normal School would evolve to become Buffalo State College.
1868	Formal programs in Industrial Arts instituted at the Imperial Moscow Technical School (Schenck, The Life and Times of Victor Karlovich Della-Vos, 1984).	Development of innovative programs in technology instruction that would have impact to many American schools, including Buffalo State College.
1871	Buffalo Normal School opens on Jersey Street between Normal Avenue and Fourteenth Street (Wofford, 1946).	Construction of the school was a joint effort of many that would continue to have lasting effects on Western New York and beyond.
1876	Victor Della-Vos’ Russian techniques of job analysis are exhibited at the Philadelphia Centennial Exposition (Schenck, The Life and Times of Victor Karlovich Della-Vos, 1984).  School of Mechanic Arts established at MIT, Boston (Bennett C. A., 1937, p. 322).	Russian techniques are introduced to a receptive and influential American audience.
1879	The first American manual training high school, the Manual Training School for Boys, is founded in St. Louis, Missouri (Lewis Jr., 1982).	This high school would start a trend in American education, including in Buffalo and was the realization of the Russian manual method in America.
1882	Samuel G. Love begins Manual Training in Jamestown (Bennett C. A., 1937, p. 422).	Influential pioneer Manual Training program in proximity to Buffalo.
1888	NYS Legislator S.M. Coon introduces the Industrial Training Act that authorizes industrial manual arts in public and normal schools	Manual Training movement in New York State rapidly expanded.

<b>Year</b>	<b>National or Local Milestone</b>	<b>Impact</b>
	throughout New York (Rogers, 1961, p. 29)	
1893	Swedish sloyd technique exhibited at the World's Columbia Exposition in Chicago (Eyestone, 1992).	The exhibit attracted attention from educators throughout the U.S. who sought to implement the techniques in their local school districts.
1895	Manual Training is introduced into Buffalo elementary schools (Upton D. S., Evolution of Manual Training in the Schools, 1903).	A need arose to educate teachers to teach classes.
1904	Buffalo Public Schools opens Mechanic Arts (later Technical) High School on Elm Street. Dr. Daniel Sherman Upton is first principal (Wofford, 1946).	Buffalo's first technical high school, established a need for technical teachers and taught technology and vocational education to high-school students. Now known as Hutchinson Central Technical High School.
1906	Douglas Commission (Davis, 2003).  Manual training classes introduced at Buffalo Normal School (Senior Class of the Buffalo Normal School, 1922).	Provided boost for forces advocating trade training in industrial education.  Introduction of manual training classes.
1909	Dr. Upton becomes principal of Buffalo Normal School (Wofford, 1946).  Seneca Vocational, Buffalo's first Buffalo public vocational school opens (Vocational Schools of Buffalo, October 27, 1911)	Dr. Upton was an influential proponent of technology and mechanics and would have a profound influence at the Buffalo Normal School.  Vocational schools in Buffalo creates increased demand for Industrial education teachers.
1910	Buffalo State's Vocational Industrial program begins with class of six students in basement of Normal School (Senior Class of the Buffalo Normal School, 1912).  Construction of new Buffalo Normal School building is authorized (Wofford, 1946).	The class was the genesis of all technology programs currently at Buffalo State College.  New school was driven by Vocational Industrial program needs.
1912	First graduates of new Buffalo Normal School Vocational Industrial course (Senior Class of the Buffalo Normal School, 1912).	New technology program solidified.
1914	New (second) Buffalo Normal School building opens, replaces original (Wofford, 1946).	A new building, constructed under Dr. Upton's leadership, had parts of it specifically designed for the Vocational Industrial program.
1915	Extension courses added in Buffalo Normal School's Vocational Industrial department for non-teachers (Vocational, 1915).	First occurrence of Industrial Arts program classes at Buffalo State being offered to non-teachers.
1917	Smith-Hughes National Vocational Education Act is established (U.S. Department of Education, 2010).	Provided funding for enhancing the Vocational Industrial program at Buffalo Normal School.
1919	New York State Vocational Teacher's Department in Albany proposed to be transferred to the Buffalo Normal School, completed in summer 1920 (Senior Class of the Buffalo Normal School, 1922).	Buffalo Normal School became the premier Vocational Industrial program within the NYS normal schools.



<b>Year</b>	<b>National or Local Milestone</b>	<b>Impact</b>
	NYS Board of Regents approves Buffalo Normal School to confer Bachelor of Science in Home Economics (Senior Class of the Buffalo Normal School, 1922).	Beginnings of the Buffalo Normal School's transformation to Buffalo State College and emphasis on vocational education.
1925	NYS Board of Regents authorizes the Buffalo Normal School to grant a Bachelor's degree upon completion of its four-year general education course (Wofford, 1946).	A milestone in continued evolution of BSC; Industrial Arts was one of the first of the NYS normal schools that offered a Bachelor's degree.
1928	First B.S.Ed. at BSC in Industrial Arts conferred (Senior Class of the State Teachers College at Buffalo, 1928, p. 30).	A milestone at Buffalo State: first Bachelor's degree granted in Industrial Arts; years before most of the other New York State normal schools.
1929	Epsilon Pi Tau is created (Tryon, 1958).	Enhanced scholarship in Industrial Arts.
1931	BSC moves to new five-building Elmwood Avenue campus; Vocational Department moved to Ketchum Hall, began to be called Industrial Arts about this time (Wofford, 1946).  Four-year BSC Industrial Arts and Vocational teacher programs submitted to NYS	Industrial arts program further enhanced.
1936	Creation of George-Deen Act	Authorized Congress to appropriate up to \$14.55 million for vocational education.
1946	George-Barden Act is established (U.S. Department of Education, 2010).	Promotes construction of vocational technical schools.
1947	First female graduate of Buffalo State's Industrial Arts B.S. Ed. Program (Senior Class of the State Teachers College at Buffalo, 1947).	Female pioneer in Buffalo State's technology programs.
1948	SUNY is formed and Buffalo State College is among its charter members (LaHood, 1972).	The future of Buffalo State is assured as it is incorporated into the new NYS college system.
1957	Sputnik 1 is launched into orbit around the Earth by the U.S.S.R (Jorden, 1957).	Initiates space race in United States and renews national dedication to enhancing scholarship in science and mathematics.
1958	National Defense Education Act is passed (Foster P. N., Lessons from History: Industrial Arts/Technology Education as a Case, 1997).	Provides funding for programs designed to enhance science and math.
1959	Victor J. Papanek hired as professor of Industrial Design at Buffalo State (State University of New York College of Education at Buffalo, 1961)	Influential designer, educator, and advocate of socially and ecologically responsible design of products, tools, and community infrastructure.
1960	Heald report issued, recommending conversion of Normal Schools to liberal arts colleges (New York State Committee on Higher Education (Heald, Henry T., Gardner, John W., Folsom, Marion B.), 1960).	Transformational period for Buffalo State College.
1963	Upton Hall at BSC is dedicated as new home of its Industrial Arts program (LaHood, 1972).	A new state-of-the-art building for Buffalo State's Industrial Arts program designed especially for its needs.

<b>Year</b>	<b>National or Local Milestone</b>	<b>Impact</b>
	Vocational Education Act of 1963 is passed.  Bachelor of Science degree in Vocational Technical education is proposed at BSC (LaHood, 1972).	The Vocational Education Act, with amendments in 1968, authorized more than \$800 million for vocational education.  Now known as Career and Technical Education degree, classes began in 1964.
1964	Dr. Paul W. DeVore writes <i>Technology: An Intellectual Discipline</i> (DeVore D. P., 1964).	Advocates for increased technology in Industrial Arts.
1966	First computer lab is created at Buffalo State College (The Computer Era Comes to Buffalo State, 1966).	Beginnings of Buffalo State's Information Systems Management program.
1968	Vocational Education Amendments Act of 1968 is passed (Perkins, 1968).	Provides additional funding for vocational education and BSC's Vocational Technical Education program.
1969	Bachelor of Science degree in Industrial Technology is created at BSC (LaHood, 1972).	An important new program, Buffalo State's first non-teacher technology program.
1971	Three new Bachelor of Science degrees are created at Buffalo State College: <ul style="list-style-type: none"> <li>• Electrical Engineering Technology: Electronics</li> <li>• Electrical Engineering Technology: Smart Grid</li> <li>• Mechanical Engineering Technology (LaHood, 1972).</li> </ul>	Buffalo State continues its expansion.
1974	Bachelor of Science degree in Information Systems Management is created at BSC; (Lewis, 2010).	Believed to be first of its kind in United States.
1977	BSC Industrial Technology program accredited by NAIT (ATMAE, 2011).	National recognition and accreditation for program.
1983	BSC Mechanical and Electrical Engineering programs accredited by ABET (ABET, 2011).	National recognition and accreditation for program.
1984	Industrial Arts and Vocational Education Department is renamed to Technology Department at BSC (Buffalo State College, 1984).  Carl D. Perkins Vocational Act of 1984 (Davis, 2003)	Name change reflected national trends. Act authorized funding focused on the improvement of vocational programs and serving disabled and disadvantaged students.  Important federal law authorizing funding for vocational education at secondary and postsecondary level.
1990	Carl D. Perkins Vocational and Applied Technology Education Act (Davis, 2003)	Reauthorized the 1984 Perkins Act and increased vocational education funding through 1995 to \$1.6 billion.
1996	President Clinton signs telecommunications bill and issues the Technology Literacy Challenge, providing funding to connect schools to the Internet (America's Technology Literacy Challenge).	National mission to make all children technologically literate by the dawn of the 21st century, equipped with communication, math, science, and critical thinking skills essential to prepare them for the Information Age.
1998	Carl D. Perkins Vocational and Technical	Offers greater spending flexibility of federal funds

<b>Year</b>	<b>National or Local Milestone</b>	<b>Impact</b>
	Education Act of 1998 (U.S. Department of Education, 2003).	for vocational education.
	Workforce Investment Act (U.S. Department of Labor, 1998).	Provides services to unemployed workers including funding for professional certifications.
2006	Carl D. Perkins Career and Technical Education Improvement Act of 2006 (U.S. Dept. of Education).	The new law includes using the term “career and technical education” instead of “vocational education,” and maintains the Tech Prep program as a separate federal funding stream within the legislation. Also includes new requirements for programs of study that link academic and technical content across secondary and postsecondary education. Provides almost \$1.3 billion in federal support for career and technical education programs in all 50 states. The law extends through 2012.
2007	Buffalo State hosts Engineers of the Future program (\$1.7 Million ‘Engineers of the Future’ Program Addresses Potential Shortage of U.S. Engineers, 2007).	Influential program by BSC provided 350 NYS teachers with knowledge and skills to ignite interest in engineering as a career path for middle and high school students.
2010	Post-9/11 Veterans Education Assistance Improvement Act of 2011 passed (U.S. Department of Veterans Affairs, 2011).	Removes limitations for certification courses and expands housing stipend for distance learners.
	BSC Technology Education receives NCATE reaccreditation certification (National Council for Accreditation of Teacher Education, 2010).	Highest level of certification for baccalaureate Technology Education program.
2013	Anticipated completion of BSC Technology Building costing \$38 million, designed by The S/L/A/M Collaborative of Glastonbury, CT (Buffalo State College, 2010).	A new building shows Buffalo State College’s ongoing commitment to the program.

Buffalo State College is an ideal institution to study the evolution and impact of traditional postsecondary Industrial Arts classes (and their impact on primary and secondary technology education) because BSC’s history parallels the development of Industrial Arts and technology education on a national level.

Buffalo State College was chartered in 1867 and opened in 1871 as the Buffalo Normal School, dedicated to the training of elementary school teachers. Initially, Buffalo State planned to have three departments: normal, collegiate, and scientific. However, initially, only the normal school was developed (Wofford, 1946, p. 44).

At the Buffalo Normal School, like many similar institutions in the United States, the industrialization of American life in the early years of the twentieth century caused vocational education to become a popular feature of public education and pressure was put on teacher education throughout the United States to train teachers in this field.

**2.2.2.1 Dr. Upton's Impact on Manual Training in Buffalo.** Dr. Daniel Sherman Upton (1864 - 1918) lived in Buffalo for just 25 years, but greatly influenced the development of primary, secondary, and postsecondary technology education in Buffalo. Within a six-year period, Upton created a secondary and postsecondary technical program both of which, although evolved from their initial implementation, continue to impact to Buffalo's public education system. Buffalo State College's entry into technology education, its Vocational Industrial/Industrial Arts program, was enhanced by Dr. Upton's leadership. He served as principal of the Buffalo Normal School when the program was founded. Upton was so associated with Manual Training and technology education he is known as the "Father of Vocational Education in Buffalo" (Wofford, 1946, p. 50). Upton was charismatic, patriotic, and a driven man with a strong personality. Yet one of Upton's most important characteristics, according to his student Louis E. Bleich, was he "never forgot to be a boy among boys" ("Father" of Technical High Eulogized; Tablet to Dr. Daniel Upton Unveiled, 1926, p. 14)..

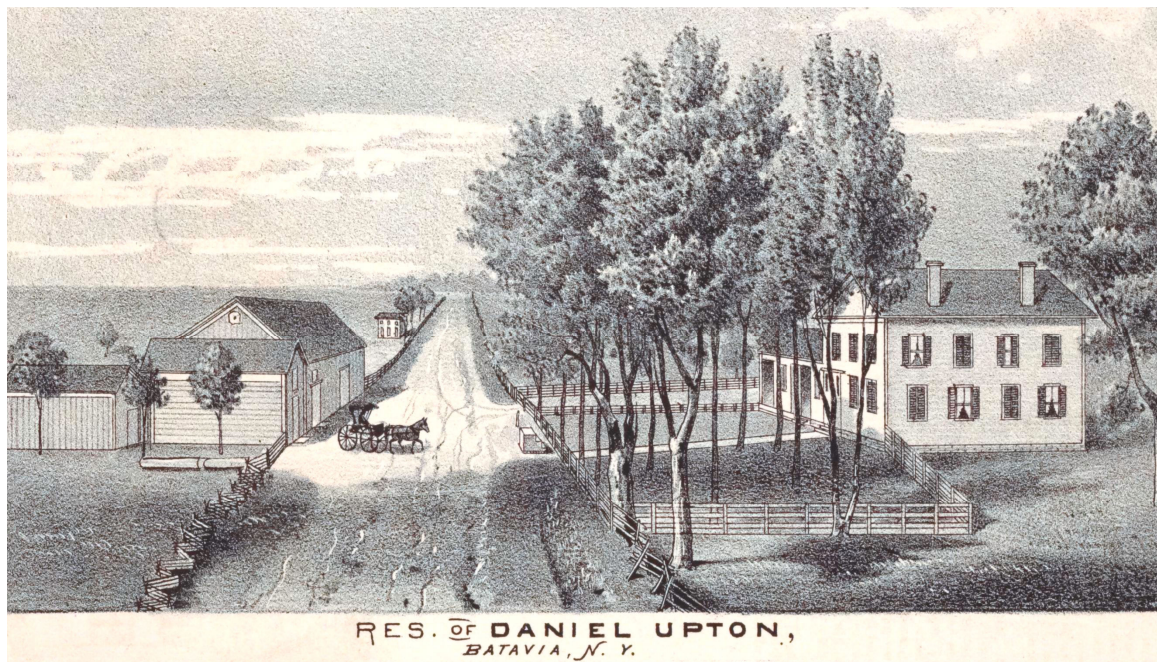
**2.2.2.1.1 Upton's early family life.** Upton was born on January 25, 1864 in Lawrence, Michigan, the son of Julia Ann Sherman (1833 – 1908) and John Bean Upton (1829 – 1896). Upton was named for his grandfather, Daniel Upton (1795 – 1888) who owned a large farm in West Batavia where he lived from 1818 until his death (Death of Daniel Upton, 1888, p. 1). John Bean Upton was born in Batavia, studied law there, but

moved in 1859 to Michigan to continue his legal studies and to begin his practice (General Upton Here Over Night, 1919, p. 8). Today, the site of Upton's Batavia farm is marked by Upton Road where the historic Upton homestead is extant, enlarged after Daniel Upton's death by his daughter, Sarah Upton Edwards. A Methodist who believed in temperance, Daniel Upton was also a zealous abolitionist and was one of seven to cast the first abolition votes in Batavia. He tirelessly aided in the operation of the Underground Railroad and it was remembered of Daniel Upton that "many a panting fugitive, seeking a home of freedom, found sustenance, protection, and safe conveyance under his prudent and skillful direction" (Upton W. H., 1893, p. 251). At the occasion of Daniel and his wife Electa's fiftieth wedding anniversary in 1871, their children and grandchildren gathered at the family homestead in Batavia including John and Julia Upton and seven year-old Daniel Sherman Upton. When the event was reported in the Batavia press, after a lengthy listing of the Upton family virtues, the newspaper said: "the only draw-back, or black mark we know of is, they are all ABOLITIONISTS AND BLACK REPUBLICANS" (Golden Wedding, 1871, p. 1). The term Black Republican was coined by Southern Democrats to describe the Republican Party, founded in 1854 by abolitionists and those who supported racial equality.

One of Daniel Upton's sons was Emory Upton (1839 - 1881), a West Point graduate and famed United States Army Brevet Major-General, military strategist, and author. He was prominent for his role during the American Civil War and was also author of several military books including *A New System of Infantry Tactics, Double and Single Rank, Adapted to American Topography and Improved Fire-Arms* (first published in 1867) and the influential volume *Military Policy of the United States*, published

posthumously in 1904 (McCulley, 1985, pp. 67-68). Emory Upton's writings had a significant impact to his nephew Daniel S. Upton's early technology education career.

The Upton family Batavia homestead, as depicted in an 1876 bucolic landscape lithograph, typifies the end of an agrarian era and the beginning of an industrial one, shown in Figure 11. The date of the lithograph is significant, as it is the year that the Moscow Imperial Technical School exhibit at the Philadelphia Centennial Exposition changed the approach to technology education in the United States.



**Figure 11. Daniel Upton homestead in Batavia, grandfather of Daniel S. Upton. Everts, Ensign & Everts, *Combination atlas map of Genesee County, New York*, 1876, p. 66. Lawrence H. Slaughter Collection, The Lionel Pincus and Princess Firyal Map Division, The New York Public Library, Astor, Lenox and Tilden Foundations, used with permission.**

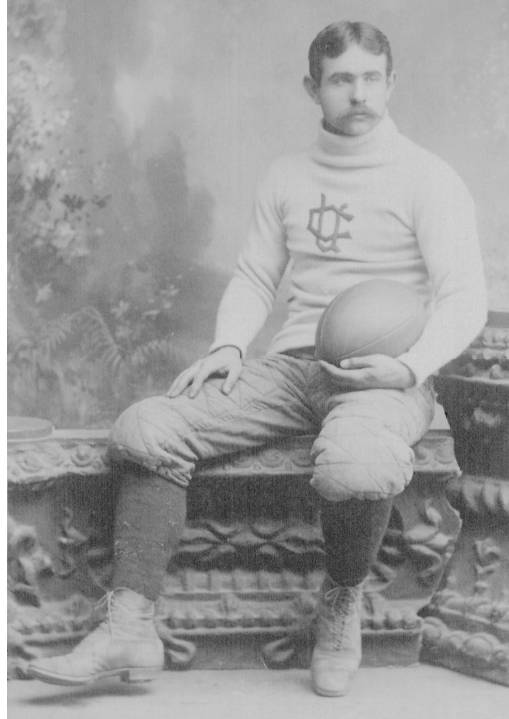
*2.2.2.1.2 Upton studies Mechanical Engineering at Cornell.* Daniel Upton began his college education at Olivet College, Michigan in 1883 where his older brother, Sherman, had attended between 1875 and 1877. During 1886-1890, in addition to studying at Olivet, Upton attended the Sibley College of the Mechanic Arts at Cornell University where he graduated in 1890 with a Mechanical Engineering (M.E.) degree.

At Cornell, Daniel Upton was very active in student life. He was an editor of *The Crank*, a monthly journal of Cornell's mechanical and electrical engineers (The Crank, 1887, p. 1). Upton's leadership ability was exhibited early in his life while studying at Cornell. When Upton was a sophomore, a dispute arose between Jeremiah Smith, owner of Casidalla Pond, and Cornell University students. Upton was described as "ringleader" of the Cornell gang and arrested for criminal mischief and destruction of property. While Upton was found guilty, he appealed the verdict (A Cornell Student Heavily Fined, 1888, p. 7).

*2.2.2.1.3 Upton's involvement with athletics at Cornell.* Upton was also involved in several team sports at Cornell, both on an athletic and organizational capacity. Among his athletic accomplishments, he was a director of Cornell's Athletic Council in 1889-1890 and Athletic Association in 1888-1889 (A Lively Day at Cornell, 1889, p. 7). Upton played the Right Tackle position on Cornell's football team in 1888 and Left Tackle in 1889, the year in which he was elected captain of the winning team. In 1889 Cornell won seven of their nine games, its only losses were two games played against top-ranked Yale, and it was the first year Cornell had played Yale (Aldrich, 1895, p. 64). That season, Upton visited Buffalo for one game on November 16, 1889 when Cornell met the University of Michigan in Buffalo at the Olympic Park Baseball grounds at Ferry Street and Michigan Avenue. Cornell won the game 66-0. Upton scored three touchdowns and stayed in the game the whole time, a notable feat considering he was slugged in the neck by one of the Michigan players (How They Did Yell!, 1889, p. 15). The 1889 Cornell football team was ranked fourth among American colleges (Bishop, 1962, p. 296). Modern football bears faint resemblance to the style of football Upton played,

which was more similar to modern rugby. Until the twentieth century, football was a savage sport and brutality was one of its attractions. The game strategy included deliberate slugging and kicking. Players had very little protective equipment; helmets had not come into use, with masks and padding not developed until the 1890s. The game was notorious for its serious injuries suffered by its players including broken bones, bruised faces and sprains. Mass plays were common, such as the V-formation where players formed a V with their arms around the players ahead of them. As the V moved forward, it enclosed the ball carrier within the apex of the V. Without any protective gear, defensive men had to hurl themselves directly in front of the V or try to crash its flanks. The game was divided into 45-minute halves and once a game started, a player could not leave unless he was injured. Because of escalating violence, rules of the game were largely revised to make it safer under the threat of its outright banning (Watterson, 2000, pp. 64-79). A photograph of Upton while he was captain of Cornell's football team is shown in Figure 12.





**Figure 12. Daniel Upton, Captain of Cornell football team, 1889.**  
Cornell University archives, used with permission.

One of Upton's closest friends at Cornell was his classmate Benjamin Marvin Harris (1866 - 1896). They were both members of the 1889 football team as well as being members of the Beta-Theta chapter of the Alpha Tau Omega fraternity. Harris was a founding member of the chapter formed in the autumn of 1887 and Upton joined on March 28, 1888 (Alpha Tau Omega, 1889, p. 147). A photograph of the 1889 Cornell football team, which includes Upton and Harris, is shown in Figure 13 (Waterman, 1905, p. 300).



**Figure 13. Cornell Football Team, 1889. Daniel Upton is in second row, second from right, holding football. To Upton's right is Benjamin Marvin Harris, with whom Upton co-authored their senior Mechanical Engineering thesis. *Cornell University, A History*.**

In addition to his annual autumnal athletic feats on the football field, during the spring season, Upton was also elected captain of the Cornell varsity crew and was a stroke member of its 1890 team (Old Tech Students Pay Honor to Upton Memory; Unveil Memorial Tablet, 1926, p. 19). During his athletic heyday at Cornell, Upton was described as “5 feet and 9½ inches tall, 164 pounds, aged 25, a muscular man of great endurance” (The Cornell Crew, 1889, p. 41). An event that took place during a June 26, 1890 crew race gave testimony to Upton’s athleticism. At New London, Cornell and Pennsylvania met. Entering on the second mile two lengths in the lead, stroke W. S. Dole’s oar struck a wave, flew from his grasp, striking him on the chest and knocking him backward on Upton, who rowed one stroke directly over him and at the next pushed

him back in place. Dole seized the oar and rowed on without a break, the men in the bow being ignorant of the occurrence. As a result of Upton's efforts, the Cornell boat maintained its lead and won by two lengths (Young, 1907, p. 31).

*2.2.2.1.4 Upton's senior thesis at Cornell.* Besides being a great athlete, Upton was also a noted scholar. Upton, with Harris, authored a mechanical engineering thesis as a requirement for graduation from Cornell: *An Original Design for a Steam Engine* (Upton & Harris, 1890). The thesis is significant because the subject matter, as chosen by Upton and Harris, discloses their academic interests and foreshadows the creation of the Mechanical Engineering program at Buffalo State College. The thesis serves as an inspiration and model of academic rigor for the program's students. The thesis is also significant because it, to the best of the researcher's knowledge, contains the only publicly-available extant engineering drawings by Upton, who was renowned for his technical drawing capabilities. Upton was so associated with mechanical drawing he continued to teach it until the time of his death, despite being a school administrator at the time (Tutthill, Three-Year Senior Class, 1919). A transcript of Upton's and Harris' thesis is included in Appendix Nine of this study.

*2.2.2.1.5 Upton named Director of Trade Schools and Professor of Mechanic Arts at the New York State Reformatory at Elmira.* In April 1890, before he graduated from Cornell, Upton obtained his first technology-related position as Director of Trade Schools and Professor of Mechanical Engineering/Mechanic Arts at the New York State Reformatory School for young men at Elmira, located approximately 145 miles southeast of Buffalo (Among the Colleges, 1890, p. 4). By accepting the position, Upton worked for one of the most influential, yet controversial, penologists of the nineteenth century:

Zebulon Reed Brockway, Jr. (1827 - 1920). Brockway's career began its stellar climb when in 1854, at 27 years old, he became the first superintendent of the Monroe County Penitentiary in Rochester, New York. Brockway was so renowned, in 1876 he was recruited to lead the new Elmira Reformatory, designed to reform first-time male felons between 16 and 30 years of age. Brockway's fame grew as his work at Elmira established him as the foremost penal authority in the United States, if not the world (Pisciotta, 1994, p. 31). Key elements of Brockway's innovative Elmira system included: 1.) diagnostic interviews; 2.) in-house reformatory treatments; and 3.) indeterminate sentencing/parole. New York State offenders, who frequently received a five or ten-year sentence for crimes such as burglary and assault, were sometimes sentenced to Elmira if they met the institution's criteria. The Reformatory appealed to inmates because of its potentially shorter incarceration period and because they could avoid the stigma of being labeled a New York State prison convict.

At Elmira, inmates were classified into three grades, with newly arriving prisoners being placed at the second-grade for their first six months. The most responsive and cooperative prisoners were promoted to the first-grade and given an opportunity to earn additional privileges (or marks) which included a reduction of their sentence or being paroled. Inmates who were resistant, or who had behavioral problems, were placed at the third-grade. Third-grade prisoners wore coarse red uniforms (the upper two grades wore black or blue uniforms), and were denied letters, library and visiting privileges. Their cells were stark and consisted only of a bed, blanket, and night bucket.

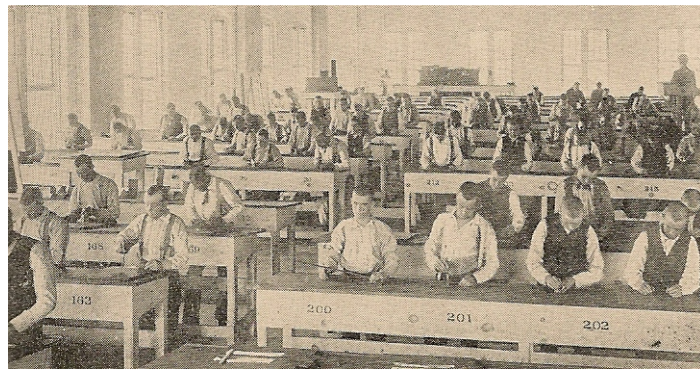
In 1883, an experimental school of Industrial Arts was introduced at Elmira, seven years after the institution's opening. Construction of a dedicated Industrial Arts school building at Elmira began in 1885, when a full curriculum was established and a limited number of trades were taught including shoemaking, ironwork, and brush making. The program was successful and the school building was enlarged between 1886-1888 with the prisoners' output being sold for income (NYS Board of Managers at the NYS Reformatory, 1891, p. 73). However, private sector opposition to competition from inmate labor compelled the creation of the Yates Law in 1888 which restricted prison shops to the production of goods commonly consumed by New York's public institutions (McLennan, 2008, p. 188).

In response to the Yates Law and the reduced emphasis on trade production, Brockway instituted an elaborate military system at Elmira in 1888. Inmates were dressed in uniforms, assigned ranks, and divided into companies. A former military officer led the young men, particularly those who were promoted to officers. The inmate-soldiers marched five to eight hours each day, under the guidelines of *Infantry Tactics in Use at the N.Y.S. Reformatory adapted from Upton's United States Army Tactics* (Upton E. , 1889). Daniel Upton's uncle, Major General Emory Upton, authored the original work upon which the adaptation was based. It is unknown whether Daniel Upton's hiring at Elmira was influenced by his being General Upton's nephew.

During his tenure at Elmira, Daniel Upton, as conductor of the technological and vocational trade school, directed the instruction of more than 1,100 young men in upwards of thirty different trades. At the school, theoretical instruction was joined with practice. Prisoners were expected to spend the morning and afternoon hours on work for

New York State when Elmira became a “vast technological training school” (Elmira Reformatory, 1892, p. 12). Evenings were divided between Elmira’s school of mechanical arts and the school of letters.

The trade school had two divisions. The first, *vocational*, was reserved for second-grade men and included classes in which the end result was production; e.g. making umbrellas, pipes and packing boxes. In the second, *preferred*, reserved for first-grade men, production was an object, though secondary to instruction. This system allowed students to acquire a technical and scientific knowledge that would have taken many years to learn in a shop. For first-grade men, Upton gave particular educational focus to mechanical drawing and had 300-400 students enrolled in his classes at any given time (Upton D. S., Manual Training Department, 1892, pp. 99-100). A photograph of Upton’s mechanical drawing class at Elmira is shown in Figure 14.



**Figure 14. Daniel Upton's Mechanical Drawing Class at the Elmira Reformatory.**  
*New York State Reformatory at Elmira Seventh Year Book, 1892.*

One of Upton’s accomplishments while at Elmira was the publication of an illustrated catalog of the institution, prepared entirely by its inmates on an in-plant printing press. The catalog included examples of lithography, photography, wood engraving, and well-printed text (Personals, 1891, p. 17).

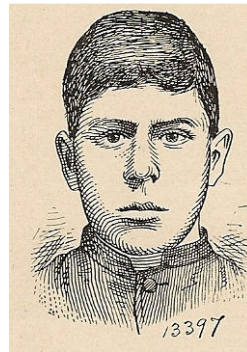
*2.2.2.1.6 Impact of Upton and Butler on Board of Charities 1893-1894 Elmira*

*inquiry.* While to the outside world the Elmira Reformatory was held in high esteem for its visionary prison reform methods and integration of technology and academic education, Elmira had a dark, sinister side. The Reformatory required its inmates' complete submission to Brockway and his directors. Each inmate was evaluated monthly in three areas: performance at school, at work, and general deportment. Three credits or marks could be earned monthly in each category, with a highest achievement of nine credits each month. At school, inmates had to earn a grade of 75 or higher to receive three marks; whereas performance at work was more subjective: inmates who worked hard received three credits; less diligent effort carried penalties. Second-grade inmates who received six months of nine credits were promoted to the first-grade. Six months of nine credits in the first-grade earned an inmate the right to appear before the parole board. Theoretically, a submissive and hardworking inmate could earn release after just one year of imprisonment, regardless of his original sentence. However, reality rarely mirrored the theoretical.

If inmates did not achieve their desired marks, it resulted in a longer period of incarceration. Rebellion and resistance came with an even higher price. A scandal erupted in 1893 disclosing the shocking brutality and torture in store for Elmira inmates who did not conform. The knowledge of a poor report for an inmate who attended Upton's school could result in torture must have put an enormous burden on him. One such example was Prisoner 13397. He was a sixteen year old boy sentenced to Elmira for burglary shortly before Upton was employed. While illiterate when admitted to Elmira, Prisoner 13397 was a good student and progressed quickly in his studies, often passing



tests with scores of 100 percent. In Upton's school of Mechanical Arts, Prisoner 13397 showed "unusual capability." Despite his intelligence and hard work, he was penalized for "misbehavior and . . . went from bad to worse until physical treatment was resorted to and the delinquent spanked several times." Fortunately for Prisoner 13397, he "recovered his senses and gave evidences of improvement" (Elmira Reformatory, 1892, p. R17). An illustration of Prisoner 13397 is shown in Figure 15.



**Figure 15.** Elmira Reformatory Prisoner 13397, a boy of less than 18 years of age, was one of Daniel Upton's students and was brutally paddled for "misbehavior." *New York State Reformatory at Elmira Seventh Year Book*, 1892.

Just a few months after Upton left Elmira, the world would come to know the meaning of "spanking" at the Reformatory. On July 2, 1893 the *Buffalo Sunday News* (and a day later its sister newspaper, the *Buffalo Evening News*), published the groundbreaking prison abuse story of Frank L. Wallace. A resident of New York City, Wallace was born about 1872 and had been living in Buffalo. He was arrested in September 1892 for stealing a \$40 gold watch from his place of employment, the St. John's House on Swan Street, known as one of Buffalo's "cheap hotels." Wallace subsequently attempted a dramatic escape by jumping from a second story window in the Buffalo jail where he was being held (A Nervy Crook, 1892, p. 5).



For his crimes, Wallace could have been incarcerated for a maximum of five years, but because of his youthful status, Buffalo Judge Seaver sentenced him to the Elmira Reformatory on October 22, 1892. Four months later, Wallace was pronounced “incorrigible” and sent to Auburn Prison to serve his full sentence on March 3, 1893 (A Brockway Victim, 1895, p. 5).

While incarcerated at Auburn, Wallace disclosed to the *Buffalo Evening News* details of the brutality he suffered during his five months at Elmira. Wallace said when he was initially interviewed by Brockway, he refused to give information to Brockway about his mother and sister. As a consequence, Wallace was kicked in the face and banished to a subterranean dungeon with no light or air, and was chained to the floor by his arms so he could not stand up. According to Wallace, “the steam pipes that ran through the cell were kept so hot that I nearly suffocated.” Wallace was chained in the dungeon in the restrained position for nine days and only given a bit of water and bread for sustenance.

More significant than Wallace’s own experiences, the *Buffalo Evening News* story revealed a glimpse of more severe torture, something that ultimately would tarnish Elmira’s sterling reputation. In the *Buffalo Evening News* interview, Wallace described the experiences of others who received beatings at the prison. Wallace stated: “Out of one draft of 50 sent [to Elmira] I am told that 35 died within a year. A great deal of this is due to weakened back and kidneys caused by the terrible floggings that are given at the Reformatory. The men are stripped and held by two strong guards while Brockway flogs them across the small of the back with a piece of rubber hose filled with water.”

When asked by the *Buffalo Evening News* reporter whether Wallace ever received such a beating, he replied: “No, but I have daily heard the screams of men who were being flogged and heard them come up the stairs crying, boys with scarcely strength enough to stand” (A Dark Cell, 1893, p. 4).

Edward H. Butler, owner of the *Buffalo Evening News* and president of the Buffalo State Normal School Local Council, surely was aware of the importance of his journalistic exposé. Helen G. Englebreck, who was Daniel Upton’s sister-in-law, wrote Mr. Butler was “engaged actively in the war for a better means of discipline in the Elmira Reformatory, then under the supervision of the famous Z. R. Brockway” (Wofford, 1946, p. 100).

The *Buffalo Evening News* article garnered the attention of Joseph Pulitzer of the *New York World* newspaper, known for its groundbreaking investigative reporting. By August 1893, *The World* located other former Elmira inmates who supported Wallace’s assertion of torture and brutality at the Reformatory. *The World* featured the story of John Gilmore, a parolee who fought his return to Elmira because of a parole violation. As a result of its investigative journalism, the *World* encouraged the New York State Board of Charities to investigate the matter further. As a result, hearings were held between October 1893 and March 1894, during which time the public learned more of the torture at Elmira. Wallace, whose story in the Buffalo News set the inquiry in motion, testified on November 11, 1893 (Another Day at Auburn, 1893, p. 2).

Elmira inmates pronounced insubordinate were subjected to a corporal punishment ritual first described in the *Buffalo Evening News* article, and further detailed during the hearings. Brockway, accompanied by two guards, would escort the inmate to

the torture chamber (bathroom no. 4), an isolated room in the southeast corner of the south wing of the south cell block, which inmates referred to as the “slaughter house.” If prisoners resisted going to bathroom no. 4, they were dragged there by the neck by means of a nine-foot iron rod with a hook at the end, after being made red-hot by it being put in a furnace (Paddled Eighteen Times, 1893, p. 1). Once at the slaughter house, Brockway paddled the naked inmate with a leather strap which was twenty-two inches long, three inches wide and nearly a quarter of an inch thick. The strap was attached to a fourteen-inch hickory handle. The handle was soaked in water before the punishment to make it heavier. After the paddling, which left the inmate bleeding, he was often punched or kicked in the head or bludgeoned with the club-like hickory stick. After the punishment was administered, the inmate’s suffering was not over. The prisoner was then delivered to a solitary cell, with minimal or no light, where he was shackled day and night, chained to the bars in a standing position for up to eleven hours at a time. The inmate was only given a slice of bread and a bit of water each day for sustenance. The Board of Charities referred to these cells as “medieval dungeons.” Butler and the *Buffalo Evening News* participated in the inquiry by providing written statements from several former inmates who could not testify at the inquiry (New York State Board of Social Welfare, 1894).

The conclusion of the Board of Charities inquiry into the allegations was “the brutality practiced at the Elmira Reformatory has no parallel in any modern penal institution in our country” (Pisciotta, 1994, p. 42). One outcome of the inquiry was Wallace was pardoned by Governor Morton on April 12, 1895 (Wallace is Free, 1895, p. 3). Others, however, were not as fortunate as Wallace. Many of those who suffered the beatings were permanently injured and several died (Another Day at Auburn, 1893, p. 2).

During the period of time Upton was at Elmira, the use of torture increased rapidly. In 1889, 261 inmates were paddled; 480 in 1890; 535 in 1891; and 621 in 1892 (Pisciotta, 1994, p. 41). In addition to paddling, Brockway also implemented other forms of torture designed to curb sexual activity. During the early 1890s, the burgeoning population at Elmira required inmates to double-up in the prison's seven-by-eight foot cells, equipped with stacked iron beds. Between 1890 and 1891 the inmate population at Elmira increased from 1,102 to 1,409 (New York State Board of Social Welfare, 1894, p. xxiv). However, double bunking its population of young men, the majority of which were between 16-24 years old, contributed to unrestrained sexual activity within the overcrowded Reformatory. At Elmira, all forms of sexual activity were prohibited and Brockway appeared to be obsessive in his attempts to prevent it. Brockway kept a chart in his office with those inmates he identified as "N.D." These were prisoners who were prohibited from double bunking because Brockway suspected they would engage in sexual activities if allowed to bunk with another inmate (Pisciotta, 1994, p. 44). Brockway's suspicions may have had some merit: during the Board of Charities inquiry, an inmate testified that some inmates asked to double-up "for immoral purposes" (New York State Board of Social Welfare, 1894, p. 1072). Regardless, the penalties for discovered sexual activity at Elmira were severe. James Boyd testified that in November 1892 inmate 4118 (McCarthy), was accused of having "improper relations" with another inmate named Bonner, one of the Reformatory's "worst characters." McCarthy was paddled so severely he died six weeks later on January 1, 1893 (New York State Board of Social Welfare, 1894, p. 57).

Similar to his use of paddling, Brockway also sexually tortured prisoners to serve as a behavioral deterrent for others. In at least six cases he ordered Dr. Hamilton D. Wey to chloroform and infibulate the penis of inmates who Brockway suspected engaged in masturbation. Wey, Elmira's resident physician during the time Upton was employed at Elmira, was the son of one of Brockway's closest allies, a trustee of Elmira since it had opened. Consequently, Wey was subservient to Brockway.

An infibulated inmate at Elmira was Herman Miller of Utica, sent to the Reformatory in April 1891 for larceny, during the period of Upton's employment (A Prisoner from Utica, 1891, p. 8). At the Board of Charities inquiry, Miller testified and gave a vivid description of his ordeal. Once Brockway ordered the infibulation, Wey chloroformed the unsuspecting inmate. Wey proceeded to place a brass ring over the glans, pulled the inmate's foreskin over the glans and pierce the foreskin with four metal rings to hold the central ring in place, making arousal painful and erection impossible. The rings remained in place until Brockway ordered them removed. When news of the torture was revealed during the inquiry, Brockway's attorney attempted to defend its use, but a physician from Auburn prison testified that infibulation was "inhumane" (Pisciotta, 1994, p. 46).

Despite the threat of infibulation and paddling, sexual activity flourished at Elmira. Wey, in a letter written to researcher Havelock Ellis during the 1890s, disclosed the extent of inmates who engaged in sexual activities with one another. When trying to estimate the number of Elmira inmates who participated, Wey wrote: "In my pessimistic moments I should feel like saying that all were; but probably eighty per cent, would be a fair estimate." As a candid rationalization of the prisoners' behavior at Elmira, Wey

observed there were many inmates “with features suggestive of femininity that attract others to them in a way that reminds me of a bitch in heat followed by a pack of dogs” (Ellis H. , 1901, pp. 16-17).

The adoption of General Emory Upton’s infantry tactics and Elmira’s use of inmate-officers had an unanticipated effect: the prison’s punishment practices provided an opportunity for sexual control and manipulation. In January 1893, an insidious, organized sex ring was uncovered and 70 inmates were charged. Investigators were incredulous in their disbelief at the extent of the inmate-officers’ involvement. Inmate-officers, when promoted to monitors, extorted sex from subordinates in exchange for marks which could lead to their promotion and early release, or could result in paddling if they did not comply ” (New York State Board of Social Welfare, 1894, p. xxxix). An inmate who testified at a hearing said: “A new boy has to submit if he wants to get along . . . It was an everyday occurrence, if he is a good-looking boy he has got to submit to an officer’s.” Another inmate testified: “The boys will submit to almost anything before they will get paddled” (Pisciotta, 1994, p. 45). Another inmate testified “to the fact that inmate keepers have keys to the cells is due to a considerable extent the great prevalence of sodomy at Elmira” (New York State Board of Social Welfare, 1894, p. 17).

Despite the overwhelming evidence of torture at the Elmira Reformatory disclosed during the Board of Charities inquiry, many refused to believe it. The *New York Sun* accused the *World* of manufacturing the case against Brockway and for using prisoner witnesses, or what the *Sun* referred to as “unclean monkeys . . . who had contrived [their] rascally schemes in the past and were accustomed to handle merrily every species of moral disease and pollution, from one prison to another through the

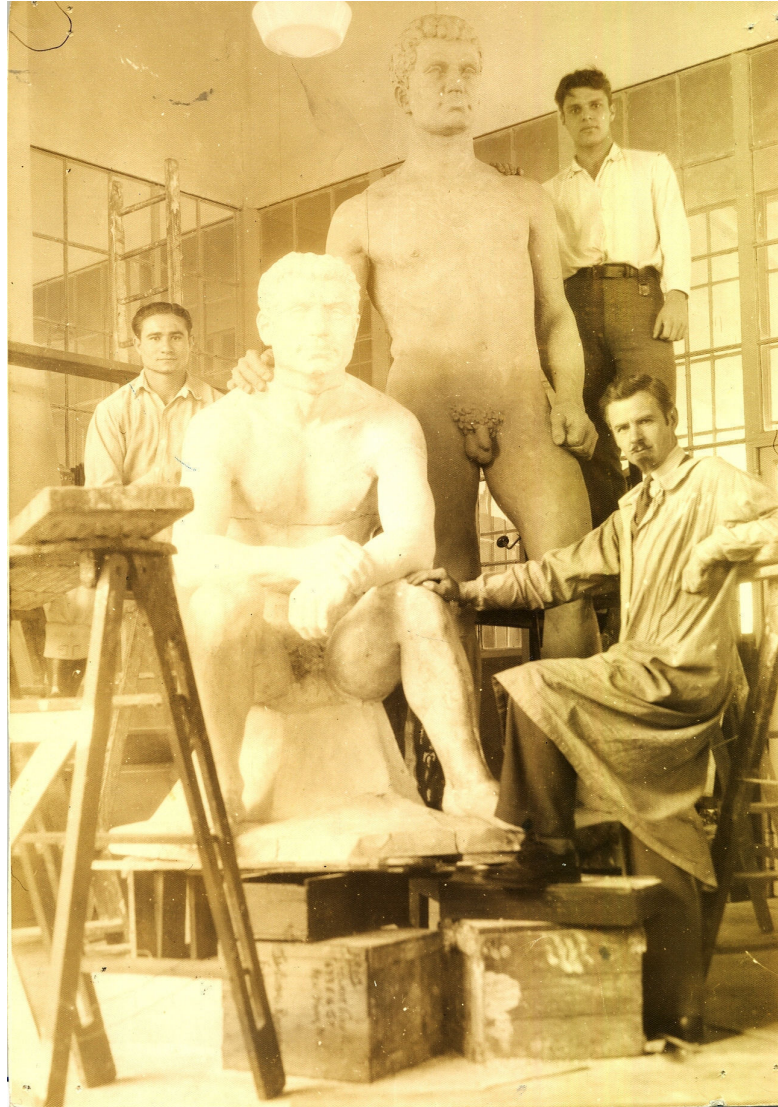
State. . .” The *Sun* speculated the prisoners’ motivation for participation in the inquiry was revenge against Brockway, a hunger keener than their own lust for sodomy. The *Sun* expressed its contempt for the *World’s* entire Elmira investigative journalism article series and dismissed it as a publicity stunt rooted in sensationalism. The *Sun* also discredited the *World’s* sources who the *Sun* claimed were simply “incorrigible convicts and sexual perverts transferred from the Reformatory” (The Elmira Reformatory. An Appeal to Truth and Reason., 1894, p. 7).

By late 1892, Daniel Upton left Elmira and his technology director position (Knox, 1917, p. 1086). Whatever the true extent of torture at Elmira, Upton was at the epicenter of the storm during the Reformatory’s period of unrestrained brutality. At the Board of Charities inquiry, evidence was presented that Upton knew, on some level, the extent of the torture or sexual abuse that occurred at Elmira if inmates did not perform as expected in his Mechanical Arts school. James Boyd, an inmate in charge of the domestic building and accused of an “offense against nature” at the Reformatory, testified Upton reported one of his students, Nevins, to Brockway for having something forbidden in his possession. Brockway flew into a rage, entered the trade building where Nevins worked and “thumped him in the face several times” until he fell to his knees. Nevins was then locked up for an extended period of time (New York State Board of Social Welfare, 1894, p. 706). Another inmate, Thomas Brown, testified he suffered repercussions for being impudent to Upton, although he was never paddled and expressed thanks for being at Elmira (New York State Board of Social Welfare, 1894, p. 1207). While Upton did not testify at the inquiry nor made any public statements about Brockway’s use of corporal punishment, later in his life Upton said his experience at the

Elmira Reformatory was one of the most interesting and fascinating times of his life. Upton's sister-in-law said at Elmira, Upton "came into contact with many and varied characters whom he took a deep and sympathetic interest" (Englebreck, 1946, p. 90).

While the direct impact of the Board of Charities inquiry to Elmira was minimal, its public reputation was tarnished. Governor Theodore Roosevelt implemented significant changes at the Reformatory in 1899 that resulted in Brockway's forced retirement a year later (Pisciotta, 1994, p. 108). The institution is presently an adult maximum security prison known as the Elmira Correctional and Reception Center, its days as a reformatory having long since passed. Its enduring legacy in penal and vocational industrial educational reform is immortalized in *Elmira, Builder of Men*, a bronze statue of two actual Reformatory inmates. Funded by the Works Progress Administration, the original was sculpted in clay and cast in plaster during the early 1940s by Ernfred Anderson. In 1949 the sculpture was cast in bronze and erected outside the Reformatory in 1951 (Gieschen, 1967, p. 126). A photograph of Anderson, the sculpture, and its two inmate models is shown in Figure 16.





**Figure 16. *Elmira, Builder of Men*, a homage to the Elmira Reformatory with sculptor Ernfred Anderson and two inmate-models from 1943. Courtesy of Chemung Valley History Museum.**

*2.2.2.1.7 Upton leaves Elmira and moves to Buffalo for mechanical drawing teaching position.* After his job at the Elmira Reformatory School, for a short time from late 1892 until mid-1893, Upton worked as a salesman for Hill, Clarke & Co., headquartered in Boston, Massachusetts. Hill, Clarke was a manufacturer of steam engines, pumps and boilers, iron and wood working machinery, shafting, and belting supplies (Cartbags, 1893, p. 8). In Upton's entire 28-year career, the few months he

worked at Hill, Clarke was the only time he was not an educator. It perhaps reveals Upton's desire to leave Elmira until a more suitable position surfaced, such as the teaching opportunity in Buffalo's public schools.

During the 1893-1894 school year, Upton moved to Buffalo and taught mechanical drawing at its Central High School night school, earning an annual salary of \$1,200 (Diehl, Annual Report of the Superintendent of Education of the City of Buffalo 1893-1894, 1894, p. 166). In 1894, Upton was named Principal (sometimes referred to as Supervisor) of Drawing for the Buffalo Public Schools (Principal Upton Elected Head of Normal School, 1909, p. 1). Until World War I, drawing and art teachers in public schools taught art for industrial purposes; after World War I, its identity had shifted to cultural purposes (Efland, 1990, p. 184).

Upton's arrival in Buffalo and his experience and advocacy of Manual Training put the right man, at the right place, at the right time. Since the 1880s, there were advocates of Manual Training in Buffalo, but none was fully successful at advancing their cause.

*2.2.2.1.8 Early unrealized attempts to integrate Manual Training into Buffalo's public schools.* Professor Love's nationally pioneering Jamestown Manual Training initiative ignited interest in Buffalo as early as 1880. That year, at the annual New York State Teachers' Association meeting held in Canandaigua, Love spoke on industrial education during a session that was described as "the most interesting feature of the whole convention." Love's industrial education discussion prompted intense interest by those in attendance, and "prominent educators pronounced this a new departure in education equal to Quincy reform" (Educational, 1880, p. 3). The Quincy System

referenced was a new educational system based on learning-by-doing” developed by Colonel Francis Wayland Parker and implemented in Quincy, Massachusetts. The system was influenced by the earlier work of Pestalozzi and Sheldon (Tolley, 2003, pp. 131-132). Love’s initiative was reported in the Buffalo press, and prompted discussion among educators and the public.

Within the next few years, prominent Buffalo education advocates became fully aware of Love’s exceptional accomplishments in Jamestown. In 1885, the alumni association of the Buffalo Central High School formed a committee, chaired by Dr. James Wright Putnam (1860 – 1938), to encourage the introduction of Manual Training in Buffalo public schools (High School Graduates, 1886, p. 4).

1885 was the first year the Buffalo Superintendent of Schools proposed inclusion of Manual Training into the public school course. That year, Superintendent James F. Crooker cited a 1882 Committee on Industrial Education report (appointed by the American Institute of Instruction) which called for “the introduction into grammar and high schools of instruction in the use of tools, not for their application in any particular trade or trades, but in developing skill of hand in the fundamental manipulations connected with the industrial arts, and also as a means for mental development” (Buffalo Department of Education, 1886, pp. 42-43). Crooker concluded his proposal by calling for the creation of a Buffalo Manual Training School modeled after the Chicago Manual Training School (Buffalo Department of Education, 1886, p. 45). Buffalo’s response to Crooker’s proposal was slow in coming. The first visible sign of progress occurred in February 1887 with the introduction of Industrial Drawing in the Buffalo Central High School (Buffalo Department of Education, 1888, p. 90).

In the summer of 1887, Love accompanied by his assistant Ms. Willard, taught an Industrial and Manual Training education session for teachers at Glens Falls. That same year, their book *Industrial Education, A Guide to Manual Training* was published. The impact of Love's session and Jamestown's Manual Training system resonated in Buffalo when it was reported it was believed at "no distant day the system will be adopted in [Buffalo's] public schools as part of the curriculum" (In the Vicinity. Reports from Various Points in the Neighborhood. Jamestown and Along the Lake., 1887, p. 3).

The seeds of Manual Training planted in 1887 at the Buffalo Central High School continued to evolve as an experiment the following year. While Upton is justly credited with beginning Buffalo's Manual Training program, his efforts were complimented and supported by another luminary in Buffalo's educational history, Henry Pendexter Emerson. Emerson, who was educated in Massachusetts, came to Buffalo in 1874 as director of the Classics Department at the Buffalo Central High School. In 1883 he became principal of the high school and in 1892 was elected to succeed Crooker as Superintendent of Buffalo's Schools (Dr. Henry P. Emerson, 1898, pp. 30-31). Emerson began his tenure as Superintendent on January 1, 1893 and remained in that position until 1918, the longest term of any Buffalo Public School Superintendent (Weed, 2001, pp. 16-17).

An experimental woodworking shop was created in the basement of the Central High School in 1888 with the support of Crooker, Emerson and the Buffalo School Board. An instructor was employed to teach boys the proper use of woodworking tools. The shop was furnished with twelve double working benches and was opened for class work in February 1888. The experiment was a success and according to Emerson, the

benefits included: boys stayed longer in school; student development was rounded out; good order and discipline was promoted; and creation of a moral force that dignified manual labor by removing false notions of degradation (Buffalo Department of Education, 1889, pp. 64-66). As a result of the experiment, Emerson “heartily endorsed” the creation of a Buffalo Manual Training School. Emerson said Manual Training had “special value to those who like books too well and those who do not like books at all” (Buffalo Department of Education, 1890, pp. 52-53).

During the 1889-1890 school year Buffalo’s Public Schools created an investigating committee to visit the city where the national Manual Training movement began: Philadelphia and its Manual Training High School (opened in 1885). The purpose of the visit was so the Buffalo delegation could observe how Manual Training was integrated into the Philadelphia public school system. The committee was positively impressed by their visit and Superintendent Crooker was more convinced than ever before of the need to integrate Manual Training into Buffalo’s school system. Crooker concluded his commentary of the Philadelphia visit to by stating:

The work of many of our schools seems to be directed almost wholly to a literary outcome, their primary end being to prepare for polite society. . . The age demands a better system; one that will . . . prepare our children for future usefulness . . . We are living in an age of high pressure civilization, and if we would withstand the strain to which our minds as well as our bodies are to be subjected, we must so train our bodies that they shall be able to meet and bear the increasing demands made upon them (Buffalo Department of Education, 1891, pp. 102-110).

Bolstered by the Manual Training experiment at the Buffalo Central High School as well as the Industrial Training Act of 1888 that authorized industrial or manual arts in all of New York State’s public and normal schools, Dr. Putnam continued his advocacy and in 1890 delivered a speech expressing the need for Manual Training to leading

educators of Buffalo. Dr. Putnam referenced Professor Love's success in Jamestown, and said he had set an "admirable example by carrying on a prosperous industrial school." At the lecture, Dr. Putnam announced the formation of a committee (consisting of representatives from the different trades, graduates of Buffalo Central High School, and Superintendent Crooker) to investigate the need and possibility of a Central Industrial School as an alternate choice to the Buffalo Central High School (Our Little Men. Manual Training Discussed., 1890, p. 6). The effort to incorporate Love's Manual Training program in Buffalo's public schools may have been aided by one other important advocate: his younger brother, Franklin D. Love (1838 – 1899). Beginning in 1863, Love was a Buffalo principal and headed the following schools: Nos. 11, 7, 1, 36, and 53 (Death of Prof. F. D. Love, 1899, p. 7).

In his final year as Superintendent, Crooker tempered his call for inclusion of Manual Training in Buffalo's schools because of the system's overcrowded and aged school buildings. Crooker said: "I do not believe that we should spend any large amount of city money in manual training while so many of our [schools] are suffering for the want of commodious and sanitary school buildings," while at the same time he reiterated "the manual training movement is along the line of progress in educational matters." Despite lack of funds, Crooker proposed Manual Training be incorporated into the planned new Buffalo high school. By the 1890s, it was recognized a second high school was a necessity, making Buffalo the only city in New York State (besides New York City) with two high schools. Crooker suggested a Manual Training department be planned for the new high school, Masten Park, and if it proved successful, it could be gradually extended to lower grades (Buffalo Department of Education, 1892, pp. 81-82).

The new Masten Park High School was constructed and it opened in September 1897 (Ross, 1983, p. 6). However, it did not contain provisions for Manual Training. Despite Crooker's attempts to create a Manual Training program in Buffalo's public schools, during the 1893-1894 school year the Buffalo Board of School Examiners echoed his later position when they stated they appreciated the value and importance of Manual Training, but "the present time is not considered opportune for the serious consideration of this question" (Diehl, Annual Report of the Superintendent of Education of the City of Buffalo 1893-1894, 1894, p. 31).

*2.2.2.1.9 Upton inaugurates Manual Training in Buffalo's public schools.* With Upton employed by the Buffalo Public Schools, he was able to rekindle interest in Manual Training because of his success at Elmira, and his particular perspective that allowed him to articulate its distinction between it and trade or occupational training. "What we do, is to give [students] the fundamental ideas; they must originate themselves after acquiring the first principles" (Training Little Hands as Well as Intellects, 1903, p. 32). Upton continued: "In Manual Training the aim is to give the child as great a range of experiences as may be practicable . . . In Manual Training, every operation must be directed by thought which is concentrated by interest. When operations become automatic, the educational value is lessened . . ." (Upton D. S., Evolution of Manual Training in the Schools, 1903, p. 4). Upton said Manual Training gave practical expression to theoretical problems:

Arithmetic finds practical expression through the medium of Manual Training and so each new feature which has been introduced, far from crowding out any study essential in the development of the child, has added interest to many of them by furnishing new avenues of expression, and education without interest is an impossibility (Upton D. S., Manual Training; Buffalo's Future, 1903, p. 4).

This exact sentiment was echoed over a century later by Dr. Myron E. Lewis, who originated Buffalo State College's Industrial Technology program, when he said students could more easily master the concepts of trigonometry and calculus when they could plot the trajectory of a rocket they designed, built and launched in some of the classes he gave (Lewis, 2010).

Although Upton was employed in Buffalo as Supervisor of Drawing, with Emerson's support, Upton was excited to implement his innovative method of Manual Training in Buffalo that incorporated both the Swedish and Russian systems (Upton D. S., Annual Report of the Director of Manual Training, 1897, p. 98).

Upton's perspective of Manual Training was significant because while it was limited to the technology, age-appropriate projects, and resources available to him at the time, his underlying educational concepts are applicable even today. Upton wrote:

"Educating the eye and the hand" has become a stock phrase for the *conventional* espousers of manual training. As I study more deeply into the matter and observe the results, it becomes more difficult for me to isolate any one separate member or faculty, which is particularly, and above the others, benefitted.

The education we desire is the one which will make a man independent in thought and action. It should teach him to observe, to compare, to judge and to act on that judgment. It has seemed to me that in manual training much more could be accomplished than simply acquiring the art of the use of tools. In fact, to teach the child the abstract use of tools, seems to me to bear the same relation to what might be accomplished in manual training, as teaching him only the rules would bear to what he should gain in the study of arithmetic.

Our work in manual training is laid down with the above thought in mind and processes in the evolution of each model are as follows:

First, conception; second, original design; third, construction.

Conception. - An idea of the use to which the model is to be put is explained to the class and the discussion led along the lines of which will



be the best constructive design, both as to utility and beauty. In all objects more or less beauty is introduced in the idea of proportions and adaptability, hence the artistic element is constantly with the pupil. The material best suited to the purpose of the model is also discussed.

Subjects for models are selected from objects which are in every-day use by the pupils. Care, of course, is exercised in selecting and presenting such models as will not involve the use of tools beyond the capacity of the pupils.

In the second step, original design, each pupil is expected to work out for himself a model which will answer the purpose desired. This process is executed through the medium of the working-drawing, and a criticism of design is at any time possible through this drawing. I believe this step is fully as great an influence in mental development as any which arises in the work. It is here that we find the pupil shutting his eyes and thinking, reaching out after original ideas, planning and weighing matters, so that he may have a model pleasing in proportion and line and fitted to the purpose for which it is designed.

The third process, construction, is what is generally looked upon as the whole subject of manual training.

In saying what I have of the second step I do not wish it to appear that I under-estimate the value of this part of the work, for, of course, it is the realization of all the other preliminary steps, and is the supreme test of making his hands bring into reality what his mind has conceived (Upton D. S., Annual Report of the Director of Manual Training, 1897, pp. 97-98)

With Upton's vision of Manual Training so clearly articulated, Emerson greatly supported Upton's establishment of Manual Training in Buffalo's schools. Emerson's support of Manual Training may have been influenced by interactions he had with Manual Training pioneer Professor Love of Jamestown. In 1885, Emerson and Love attended a New York State holiday conference of high school and seminary principals (The School Principals' Conference, 1885, p. 4).

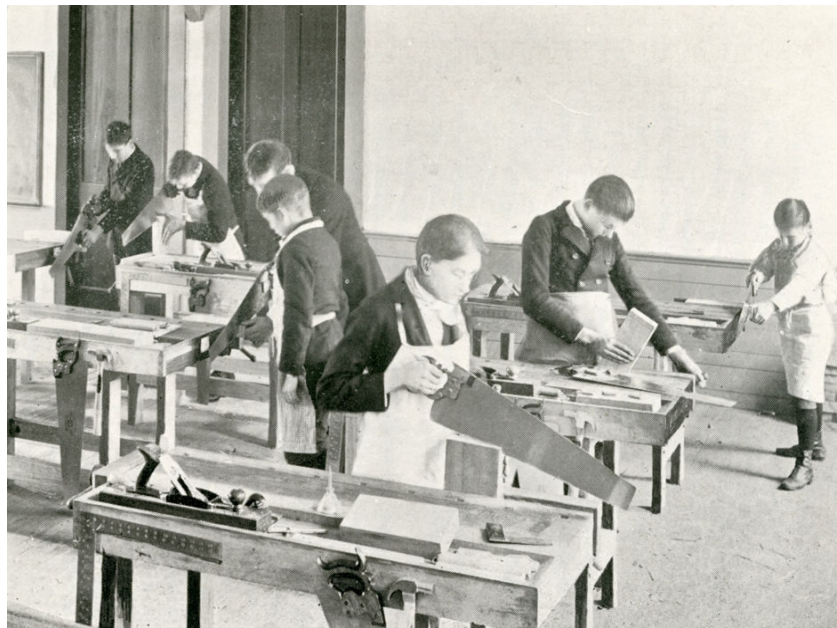
During the 1894-1895 school year, Emerson named Upton Director of Manual Training; in addition, Upton continued to retain his previous position as Supervisor of Drawing. Upton received two annual salaries: \$500 for his Manual Training position

and \$1,300 for his drawing position (Buffalo Department of Public Instruction, 1895, p. 209). The event was a milestone as it was the first time the Buffalo Public Schools had a Director of Manual Training. That year, Upton ushered in Manual Training in a very small way through his drawing program when he introduced paper-cutting and folding into primary grades (Emerson, Superintendent's Annual Report, 1896, p. 26). The program would be expanded during the following school year, 1895-1896.

Upton's efforts were concurrent with wide-spread community support to establish a comprehensive Manual Training curriculum in Buffalo's school system. A Buffalo businessman encouraged Upton to begin a program in Manual Training when he asked a question that was singularly appropriate for Upton: "The best course of training is at Elmira Reformatory and a person must be criminal to get it. The State recognizes the benefit of technical training for criminals, why not before they become so?" (Upton D. S., *Evolution of Manual Training in the Schools*, 1903, p. 4).

In the fall of 1895, Emerson gave authorization to Upton to begin an official Manual Training program, although in a limited way. Emerson said "I have decided that the best way to ascertain whether there is any demand for it would be to introduce it in a small way" (Emerson, Superintendent's Annual Report, 1895, p. 37). With Emerson's support, Upton established a class in Manual Training for eighth and ninth grade boys in an annex (a frame building in the yard) to School No. 31, 365 Emslie at Krettner Streets. The room was fitted with 18 cabinet-makers' benches and equipment. Classes were held on Tuesday and Thursday afternoons after school (Upton D. S., *Evolution of Manual Training in the Schools*, 1903, p. 4). Classes were also held on Saturday mornings for students from more distant schools (Upton D. S., *Report of the Director of Manual*

Training, 1903, p. 73). In all, about 50 students were members of Buffalo's Manual Training inaugural class (Upton D. S., Report of the Director of Manual Training, 1896, p. 77). The Board of Examiners reversed their earlier non-committal position on Manual Training by stating that the board was confident that Manual Training's growth would be "wholly dependent upon the availability of funds for its support, as the interest manifested at the present time is such as to offer abundant encouragement" (Diehl, Fourth Annual Report of the Board of School Examiners for 1895, 1895, p. 48). A photograph of Upton's first Manual Training class from 1895 is shown in Figure 17.



**Figure 17. Daniel Upton's first Manual Training Class, 1895, in School No. 31.**  
*Annual Report of the Superintendent of Education, 1894-1895.*

*2.2.2.1.10 Manual Training experiences rapid growth in Buffalo.* Upton's Manual Training efforts received national exposure when Buffalo hosted the National Education Convention in July 1896. Upton headed the Manual Training committee, responsible for special departments of the convention. Also on the committee were: Miss McDuffee, Miss Buckner, Miss Ashton, Joseph Churchyard, and Mr. Carpenter (N.E.C Committees, 1896, p. 9).

During the 1896-1897 school year, Manual Training classes were also included at School No. 51 at 101 Hertel Avenue (the only extant school structure in which Dr. Upton taught Manual Training classes to children). Manual Training classes at School No. 51, like No. 31, originally were started in an annex, but then moved into a newly-constructed building (Emerson, Superintendent's Annual Report, 1896, p. 27). District-wide registration for Manual Training classes during the 1896-1897 school year increased nearly 400 percent, fluctuating between 183 and 196 (Upton D. S., Report of the Director of Manual Training, 1896, p. 78).

Upton was pleased with the genesis of his Manual Training program. He said:

I can only feel gratified at the progress made by the boys in their work. The stimulus they acquire towards independent, systematic effort can be readily seen as they advance from problem to problem.

As I have incidentally noted, I do not think manual training a sure cure for all viciousness, but when a boy has been trained to advance thoughtfully upon a task and has the self-reliance born of tasks successfully performed, that boy is far less liable to waste his powers and make a ship-wreck of life through lack of the rudder – concentration of energies (Upton D. S., Report of the Director of Manual Training, 1896, p. 79).

In addition to those benefits already identified, Upton stated Manual Training improved self-control, self-reliance, power of concentration and coordination of the muscular and nervous system (Upton D. S., Report of Director of Manual Training, 1898, p. 97). To this list, three years later Upton added these additional benefits of Manual Training: independent thought and the power of individuality, perseverance, and ingenuity. Upton said his students were asked to “think of something that will be particularly useful . . . and are then expected to design and make it . . . if it is useful and is

the expression of the boy's individual thought, it has helped in the formation of his character" (Mothers' Club Meeting, 1901, p. 3).

Many other nationally-influential educators also extolled the benefits of Manual Training for children at the same time Upton did so through speeches and accomplishments. John Dewey wrote an influential article published in 1901 in which he advocated for inclusion of Manual Training into school curricula on a national level.

Dewey said:

It is of the manual training, the work with cardboard, wood, bent iron, the cooking, sewing, weaving, etc., that we have more directly to do... No one any longer doubts the thorough training of the hand and eye, and (what is of greater importance) of the hand and eye co-ordination, which is gained through these agencies. Recent psychology has made it unnecessary any longer to argue the fact that this training of hand and eye is also directly and indirectly a training of attention, constructive and reproductive imagination, and power of judgment . . . The old emphasis upon the strictly intellectual elements, sensations and ideas, has given way to the recognition that a motor factor is so closely bound up with the entire mental development that the latter cannot be intelligently discussed apart from the former (Dewey, *The Place of Manual Training in the Elementary Course of Study*, 1901, p. 194).

The Buffalo School Board of Examiners, who had expressed doubts about the incorporation of Manual Training into Buffalo's schools, by 1899 revised its position and stated its incorporation into the district curricula resulted in students developing "closeness of observation, accuracy of perception, quickness of eye, facility of hand, and care and judgment in expression . . . The pupil learns to do by doing" (Mahony, 1899, p. 44).

The introduction of Manual Training into Buffalo's elementary schools was a success, and the program reached another important milestone: it was expanded to include classes in the evening for adults. Dr. Upton said, "In 1897, the work had so

spread in popularity that my entire time was required to handle the classes of boys and men who flocked to the day and night classes.” Soon thereafter, Manual Training classes were expanded to School No. 14 at 364 Franklin Street and No. 18 located at 770 West Avenue at School Street (Manual Training in the Buffalo Public Schools, 1904, p. 13). During the 1897-1898 school year, Upton noted despite increased capacity to teach Manual Training, 175 applicants had to be turned away for admission due to the program’s popularity (Upton D. S., Report of Director of Manual Training, 1898, p. 97).

It is difficult to differentiate the Manual Training program’s success from the popularity of Dr. Upton; he was much beloved by his students and their parents. Not only was Upton instrumental in creating Buffalo’s Manual Training program, but in 1899 he also created a summer camp for boys in Orillia, Ontario that was a huge success for over a decade (Principal Upton of Technical High plans a Summer abroad, 1908, p. 5). At one memorial season in 1900, the boys of Upton’s camp pursued a porcupine that they mistook for a bear cub. They drove it up a tree and informed Upton that they had found a cub. Upton pursued the creature with his rifle, but upon discovering that the presumed cub was a porcupine, he captured the creature by climbing up the tree and lassoing it. Although Upton received several of the porcupine’s quills during the capture, he was successful and presented the animal to the Buffalo zoo (Some Quills are Missing, 1900, p. 6).

It was also during the 1890s that Dr. Upton began to teach not only children, but teachers as well, foreshadowing his position at the Buffalo Normal School. In the summer of 1895, Dr. Upton taught a drawing summer school class for teachers at the Owego, New York Mid-Summer School, from July 15 until August 2, 1895. It was said

Dr. Upton's "accurate training in this subject at Cornell university, where he is graduated in mechanical engineering, coupled with his masterly way of presenting the subject, makes it important that teachers should not lose this opportunity of taking three weeks' faithful work under his instruction. There will be six classes each day to meet all needs" (Winslow, 1895, p. 416). Upton continued this tradition; in 1909, he taught a session at the Springville Teacher's Institute (Teachers' Institute Now in Session at Springville, 1909, p. 3). Dr. Upton, of seemingly boundless energy, also during the late 1890s taught in the Franklin School in connection with the School of Pedagogy (Daniel Upton is Named Principal, 1909, p. 7).

The 1898-1899 school year was notable because since the first time since the inception of Buffalo's Manual Training program, Upton obtained an assistant, William Thomas Bawden (11/6/1875 – 4/27/1960). Upton's salary was \$1,600 and Bawden's was \$800 (Buffalo Department of Public Instruction, 1898, p. 241). Bawden, who was about 23 years of age at the time he was named Upton's assistant, became well known in his own right as his career matured.

Bawden's four-year tenure at Buffalo shows the complexity of the emerging field of technology education. When Bawden was hired as the first assistant teacher in Buffalo's Manual Training Department, he was the only available candidate with a college preparation to teach manual training. Bawden earned an A.B. degree from Denison University in June 1896 and completed a year of post-graduate study at the Rochester Mechanics Institute (now RIT) in 1897-1898 for manual training teachers and supervisors in secondary schools. Like Upton, Bawden's first post-graduate technology

teaching position was at the Elmira Reformatory, where he taught wood turning and pattern making from March until August of 1898 (Bawden W. T., 1914, p. 195).

During the 1899-1900 school year John F. Criswell was hired to teach in Buffalo's growing manual training program. Criswell was a skilled carpenter with only a high school education. During the 1900-1901 school year, a cabinetmaker, Henry J. Baker, was hired as the department's fourth teacher. Despite the differences in education between Bawden, Criswell and Baker, during that year, Upton earned \$1,600, Bawden earned \$900, Criswell earned \$750, and Baker earned \$700 (Buffalo Department of Public Instruction, 1901, p. 184). Frustrated by the salary differential, half a century later, Bawden said:

I compared the projects made by my boys with those turned out by the pupils of the skilled mechanics, and discovered that I did not make a good showing. I talked over prospects for the future with Upton and with Dr. Henry P. Emerson, superintendent, and received little encouragement. With an ample supply of prospective teachers in the skilled trades, and the wages of mechanics being what they were in those days, there was no necessity or inducement to pay a premium for a college-trained teacher. I decided that the only way to meet that kind of competition was to secure more and better preparation, and to qualify myself to render service of a type and quality which could not be duplicated by teachers drawn directly from the trades (Bawden W. T., 1950, pp. 15-16).

As a result, Bawden left Buffalo before September 1902 (prior to the start of the 1902-1903 school year) to study under another educational luminary, Charles Russell Richards at Columbia University in New York from which Bawden obtained B.S. and Ph.D. degrees. Subsequently, Bawden moved to Illinois where he directed the Manual Training Department of Illinois State University and became assistant dean in the college of engineering at the University of Illinois (Ohles, 1978, p. 102).



By 1903, Buffalo's Manual Training program had matured to the point where there were eight Manual Training Centers in elementary schools, taught by Upton and five dedicated teachers. Besides the four schools already mentioned, the following also incorporated Manual Training: No. 11 at 102 Elm Street, No. 33 at 157 Elk Street, No. 44 at 1369 Broadway at Person Streets, and No. 26 (the truant school) on Dole Street (Training Little Hands as Well as Intellects, 1903, p. 32).

*2.2.2.1.11 Buffalo's Manual Training accomplishments shared with regional and national audiences.* Dr. Upton and Buffalo's influence in the area of Manual Training continued to grow. In 1901, The Eastern Manual Training Association (the national Manual Training teachers' association), was headed by president William Elmer Roberts of Cleveland and held its annual meeting in Buffalo on June 27, 1901 to coincide with the Pan-American Exposition (Vroom, 1901, p. 31). Upton was excited by the prospect of having the national association in Buffalo and he expected the meeting would yield "increased enthusiasm" for Buffalo's Manual Training efforts and the creation of a Technical High School (Upton D. S., Report of the Director of Manual Training, 1900, p. 73). Upton served as secretary of an organization called the Teachers' Pan-Tourist Company which was organized to furnish teachers visiting Buffalo with accommodations at reasonable rates, low enough for a teacher to live in Buffalo during the entire Exposition (Brevities, 1900, p. 176).

The meeting was significant because for the first time it exposed Buffalo to a national audience of influential Manual Training instructors and decision makers. Superintendent Emerson gave a welcome to the audience and said "he had been in sympathy with manual training from the beginning, and was gratified to observe the

steady improvement which had taken place in the quality and quantity of the work in the Buffalo schools under the direction of Mr. Upton” (Vroom, 1901, p. 31). A highlight of the meeting was an address by Mr. Elbert Hubbard and a tour of the Roycroft Campus in East Aurora with its craftsmen that were a living embodiment of the principles of Manual Training and the Arts and Crafts movement. At the conclusion of the annual meeting, Dr. Upton was elected president of the Eastern Manual Training Association (Vroom, 1901, p. 40). There was one other ironic outcome from this meeting. It was during the Buffalo conference that William T. Bawden met with Charles Richards about his lack of career options in Buffalo and Richards encouraged Bawden to pursue further education in New York (Bawden W. T., 1950, p. 16). As president, Dr. Upton chaired the Eastern Manual Training Association’s 1902 annual meeting held in Pittsburgh (Bennett C. A., 1937, p. 496).

Upton continued to be associated with this and other organizations such as the National Society for the Promotion of Industrial Education. It was these types of national membership based professional trade organizations such as the Eastern Manual Training Association that in the late twentieth and early twenty-first centuries would create homogenized professional certification programs.

One of the vehicles of Dr. Upton’s enormous influence was his rich oratory skills that enabled him to be an inspiring speaker. Even while just a sophomore at Cornell University, Upton was a featured speaker when his class visited Auburn and he gave an address called *On Life’s Work*. In his closing remarks, Upton stirred the audience when he said:

We have been accustomed to associate heroes with war and bloodshed and yet there is now a chance for heroic action as much as was presented to

any generation. The generation preceding is passing into the shades of the past and we are emerging on the stage of life with the grave duties of citizenship coming upon us. Shall we be false to the trust or shall we try to rid her of the dangers which threaten? We may not all be the Washingtons, the Lincolns, the Grants of the political struggle, but if we be manly men who cast our ballots and use our influence to sway the government paths which honest duty points out, though we may die unhonored and unsung it may be written of us that we were loyal men. Let the so called culture and polish of today sneer at humble pride; let art scorn unpolished wrath. Learning from her proud eminence may lay claim to honor. But let us remember that:

*A ruddy drop of manly blood  
The surging sea outweighs.*

Let us be true to our principles of justice; be loyal to our country; and men to our fellow men. Let us remember that we are the keepers of America's honor and when we shall yield the trust to other hands, may it be unsullied by acts of ours have, cleansed from the stains which now we must recognize. May she be in truth as she has been – America, just, free, honored America, the honor of loyal, patriotic, manly men (Cornell's Sophmores, 1888).

Upton continued to lecture outside the classroom and promote Manual Training and Industrial Education throughout his educational career. Just a few examples of his addresses include one he delivered in 1899 to the Principals' Association: *What Should Manual Training Accomplish in Primary and Secondary Schools* (Principals' Association, 1899, p. 3). In 1901, Upton gave an address to the Mother's Club entitled *Industry as an Aid in Character Building* (Women's Organizations, 1901, p. 21). In 1902, MIT president Henry Smith Pritchett gave an address in Buffalo entitled *The Place of Industrial Training in the Education of the Modern Nation*. Upton, along with Emerson, were scheduled to discuss Pritchett's address from an educational point of view (College Presidents, 1902, p. 9). Also in 1902, Upton spoke to the Charity Organization Society of Buffalo on the topic *Why is Manual Training Taught in Public Schools and How Much are We Doing in Buffalo* at the Genesee Hotel (Manual Training Talks, 1902, p. 9). In

1903, Upton gave an address to the public on *Manual Training in Public Schools* (Mr. Upton to Speak, 1903, p. 17). In 1906 while Upton was principal of the Technical High School, he delivered an address, *Needs of Mechanical Training*, to the New York State Builders Association (State Builders, 1906). In 1909, while he was principal of the Normal School, Upton gave a series of stereopticon lectures to benefit the school and various other societies (Social Calendar, 1909, p. 5). In 1911, Upton, along with William B. Hoyt, were the featured speakers for the largest Cornell Alumni Association banquet at that time with over 300 in attendance (Cornell Dines Tonight, 1911, p. 6). In 1913, Upton gave the opening address to the annual meeting of the Genesee County Teachers' Association in Batavia, his family's hometown (Big Meeting at Batavia, 1913, p. 43). In 1916, Upton lectured on education to the West Side Businessmen and Taxpayers' Association (where he suggested women should be drafted to serve as school teachers) (Want No Railroad Track on Bridge, 1916, p. 6). In 1917, Upton delivered the address *Does It Pay* to the rural teachers of Genesee County (Rural Teachers Called Together, 1917, p. 6). Ever the patriot, Upton gave an inspiring talk on the duty of the citizens of the democracy of the United States on April 25, 1917 during the annual vocational banquet at the Buffalo Normal School (Senior Class of the Buffalo Normal School, 1917, p. 65). In addition to these specific speaking engagements, Upton maintained an active club life where he was able to socialize with Buffalo's industrial leaders. He was a member of the University Club, Park Country Club, and Rotary Club (Knox, 1917, p. 1086). Upton was also a member of the Pioneer Club (Daniel Upton, Normal School Principal, Dead, 1918).

*2.2.2.1.12 Upton and Emerson dream of a Buffalo Technical High School.*

Because of his efforts and ability to speak about the benefits of Manual Training to the public, Upton was successful in his implementation of Manual Training in Buffalo's elementary schools. However, he had a higher objective to which he long aspired: to convert School No. 11 (an elementary school) into a technical high school. Upton said Buffalo needed a dedicated "technical high school where an advanced grade of manual training could be taught to young men who could not afford to attend the colleges of technology in other parts of the country" (Training Little Hands as Well as Intellects, 1903, p. 32).

The idea of a technical high school was brought up as early as the mid-1880s to the Buffalo School Board and Common Council. In 1890 Superintendent Crooker announced to the local press: "I am strongly in favor of establishing another high school, where manual training and advanced book learning can be combined" (Some Practical Sciences. The Study of Electricity at the City Schools--Original Work at the Normal., 1890, p. 7). While nothing immediately came of Crooker's vision, Upton reinvigorated the idea in 1897 when he made an urgent plea:

Next year we will have in the neighborhood of a hundred boys who enter the high school, but who desire to continue the manual training work. Many of these are boys who, after graduating from the high school, will enter technical schools, while, for a greater number, the high school will be the limit of their school education. To both of these classes a training along the lines of applied sciences is of the greatest importance. Boston, Brooklyn, Washington, Baltimore, Cleveland, Indianapolis, Louisville, Chicago, St. Louis, and many other cities have already opened such high schools, where theory and laboratory practice go hand in hand (Upton D. S., Annual Report of the Director of Manual Training, 1897, p. 99).

Upton saw the creation of a Buffalo technical high school as the fulfillment of democratic ideals. He believed the creation of such a high school would allow students

to access the “new life in which culture and commerce are blended, and in which the educated artisan is on the same social plane as the man of letters.” He continued:

Social barriers are being broken down, and in no way can we give greater aid to the idea of social equality, where the standard is man’s own worth, than by giving to our oncoming generations an education in which intelligent labor and thought, expended in dealing with the forces of nature, ranks equally with the purely literary studies . . . (Upton D. S., Annual Report of the Director of Manual Training, 1897, p. 100).

Upton had the opportunity to realize his vision for a technical high school just a short time later during the 1902-1903 school year. Until 1902, no official recognition had been given to Buffalo’s Manual Training program by New York State officials, but in the spring of 1902, the high school Technical Course, proposed by Superintendent Emerson, was accepted by the New York State Board of Regents for use in the day school (Upton D. S., Manual Training; Buffalo's Future, 1903, p. 4).

In the Technical Course, mechanical arts and drafting received equal credit with literature and history. Shop practice included bench work and wood turning in the first year; molding and pattern making in the second year; forging in the third year; and machine-shop practice in the fourth year (Manual Training in Our Schools, 1904, p. 12). The shop practice was combined with architectural and mechanical drawing, natural science, mathematics, and enough history and literature to complete a four year high school course (Buffalo Common Council, 1904, p. 1125).

There were three specific courses included within the approved Technical Course of study: A.) Technical College Preparatory, B.) General Scientific, and C.) Industrial (Buffalo Department of Public Instruction, 1908, p. 86). Course A was arranged to meet the requirements of students who aimed to enter higher learning institutions of engineering science such as MIT or scientific colleges of the universities of the day.

Course B was very similar to the ordinary high school curriculum of the period, however, it also included a thorough training in drawing, architectural or mechanical design and the elements of mechanic arts. Course C was the only one of the three that did not lead to a Regents certificate, but graduates received a letter of recommendation from the Superintendent and from the Principal stating the classes completed. Course C was designed primarily for students who expected to enter industrial employment directly after graduation from high school (Sudrow, 1907, p. 20). The full course list, classes required and number of hours of instruction each week is shown in Table 2.

**Table 2. Technical High School Course of Study designed by Drs. Upton and Emerson.**

COURSES	FIRST YEAR		SECOND YEAR		THIRD YEAR		FOURTH YEAR	
A. TECHNICAL COLLEGE PREPARATORY	English	4	English	3	English	3	English	3
	German or French	5	German or French	5	German or French	5	German or French	5
	Ancient History	5	English History	3	Intermediate Algebra	5	Advanced Algebra	3
	Algebra	5	Geometry	5	Solid Geometry	5	Trigonometry	2
	Freehand and Mechanical Drawing	4	Mechanical Drawing	4	Physics	5	Chemistry	5
	Joinery	4	Pattern Making	6	Mechanical Drawing	4	Machine Design	4
					Pattern Making	6	Forging	6
B. GENERAL SCIENTIFIC	English	4	English	3	English	3	English	3
	Algebra	5	Geometry	5	German or French	5	German or French	5
	Physiology, Botany or Physical Geography	5	Ancient History	5	English History	3	Chemistry	5
	Elementary Drawing	4	Mechanical or Architectural Drawing	4	Physics	5	Trigonometry	2
	Advanced Drawing	4	Pattern Making or Advanced Joinery	6	Mechanical or Architectural Drawing	4	Mechanical or Architectural Drawing	4
	Joinery	6	Shop or Drawing	4	Forging or cabinet making	6	Machine Shop or Advanced Cabinet Work	6
					Shop, Mechanical Drawing or Electrical Laboratory	2	Shop, Mechanical Drawing or Electrical Laboratory	4
C. INDUSTRIAL	English	5	English	3	English	3	Civil Government	3
	Physiology	5	Algebra	5	U.S. History	5	General History	5
	Shop Arithmetic	5	Physical Geography	5	Physics	5	Chemistry	5
	Mechanical or Architectural Drawing, Freehand Drawing	4	Mechanical or Architectural Drawing	4	Mechanical or Architectural Drawing	4	Mechanical or Architectural Drawing	4
	Joinery	10	Pattern Making or Advanced Joinery	10	Forging or Cabinet Work	10	Machine Shop or Advanced Cabinet Making	10
							Shop, Mechanical Drawing or Electrical Laboratory	4

*2.2.2.1.13 Manual Training courses for Buffalo's high schools begin.* In May 1902 Emerson made a recommendation and received subsequent approval from the Buffalo Common Council to implement the new high school Technical Course (Buffalo Common Council, 1902, p. 1170). Classes began in September 1902 at School No. 11. The Technical Course was made available to Buffalo's high schools students, described an optional applied sciences course with an emphasis on Manual Training (Emerson, Superintendent's Annual Report, 1902, p. 23). In preparation for the new program, additional equipment was installed in a single room at School No. 11 including electric-driven lathes, cabinet benches and drawing tables with the hope students from Buffalo's existing high schools that would enroll in the new course (Upton D. S., The B. T. H. S., 1907, p. 8).

Approximately 100 high-school students enrolled in the Technical Course during the 1902-1903 academic year. Students from Buffalo Central and Masten Park High Schools attended School No. 11, while students from Buffalo's third high school, Lafayette, attended Manual Training courses in elementary School No. 53 at Winslow and Roehrer Streets. High school students who enrolled in the Technical Course from Central and Masten Park High Schools attended literary classes in their primary high school and attended their Manual Training classes at School No. 11. In addition to high school boys, elementary students from Schools Nos. 6 (248 South Division Street), and 13 (278 Oak Street) also continued to attend School No. 11 for Manual Training classes as they had no shops of their own (Where the Boy uses his Hands, 1904, p. 4).

During the 1903-1904 school year, the Evening Technical High School was organized, an outgrowth of the technical courses at the Central Evening High School



(Emerson, Superintendent's Annual Report, 1903, p. 29). About 180 adult students attending the evening classes held on Monday, Wednesday and Friday nights. Courses included architectural drawing, mechanical drawing, sheet iron, working freehand drawing, as well as rudimentary Manual Training including cabinetmaking. Classes were also held in algebra, arithmetic and other academic studies (Where the Boy uses his Hands, 1904, p. 4). The Evening Technical High School continued to be popular; in 1904 168 students reported for classes (Many Enroll for Night Schools, 1904, p. 7).

Perhaps because of Upton's establishment of the high school Technical Course in 1902-1903, that same year, public demands to establish a program of manual and industrial arts at the Buffalo Normal School began to be heard. In January 1903, Millard F. Bowen, secretary of the Buffalo Manufacturers' Club, challenged Buffalo to leverage New York State's normal school laws which included a provision "for industrial and training schools and practically authorized the expenditure of state moneys to establish and support them." Bowen called on the Buffalo Normal School trustees to create new buildings on the Normal School campus to be used for instructing apprentices in mechanical trades. Bowen said his:

interest in the plan is wholly in the interest of Buffalo and her manufacturing industries . . . At the present time, there is a dearth of skilled mechanics . . . To remedy this, I propose having a normal school on the present unoccupied ground where young men, and young women, too for that matter, could be taught the manual and industrial arts and get practical training . . . With a great industrial school as an addition to the Buffalo Normal School, Buffalo would really have another college (School to Train Young Mechanics is Badly Needed, 1903, p. 6).

The need to supply trained students to meet Buffalo's industrial needs was echoed years earlier by Upton when he said Manual Training would prepare students thusly. He said: "Surely Buffalo, which seems destined to lead the van of manufacturing cities, will

not be remiss in her duties in the preparation of those who are to make and direct her future greatness” (Upton D. S., Report of the Director of Manual Training, 1896, p. 81). Emerson agreed, and stated a Technical High School was urgently needed and Buffalo was “destined to be a great manufacturing city” (Emerson, Superintendent's Annual Report, 1902, p. 24).

While no results initially came from Bowen’s proposal, the high school Technical Course at School No. 11 continued to grow. The school was attended by high school students from Central and Masten, as well as elementary school students who continued to attend classes at School No. 11. In 1903 Emerson said School No. 11 was “serving a triple use, being occupied on regular school days by high school boys, on Saturday by teachers’ classes, and evenings by students of the technical evening high school” (Emerson, Superintendent's Annual Report, 1903, p. 29). Attendance during the 1903-1904 school year was in total about 300 students (Manual Training in One of Buffalo's Public Schools, 1903, p. 17). Although though the high school Technical Course curriculum was successful, Emerson and Upton’s vision was to include academic high school courses at School No. 11 so students who planned to attending college, especially colleges of technology, could attend just the technical high school and not have to commute to the other high schools. At the time, students from Central and Masten High Schools attended School No. 11 for their Manual Training classes (Manual Training in the Buffalo Public Schools, 1904, p. 13).

At the conclusion of the 1903-1904 school year, the school’s facilities needed to be upgraded to support the four-year Technical Course curriculum. The third year of the Technical Course called for a forge shop, but there was none. In May 1904

Superintendent Emerson appealed to the Buffalo Common Council for an appropriation to build a brick, one-story forge shop in the rear of School No. 11 for the 1904-1905 school year (Buffalo Common Council, 1904, p. 1125). Emerson's proposal to build a forge shop was endorsed by the Manufacturers Committee of the Chamber of Commerce (Buffalo Common Council, 1904, p. 1203). However, there was a small issue with the forge shop's construction. In June, the Common Council approved the proposal and authorized bids for the forge shop's construction and equipment (Buffalo Common Council, 1904, p. 1380). In July 1904, Emerson asked the Council education committee to authorize construction of the forge shop based on plans and specifications prepared by Upton. Deputy Building Commissioner Henry Rumrill Jr. objected to Upton being responsible for the plans. A compromise was reached where Rumrill's department was responsible for creation of the plans under the direction of Emerson and Upton (There was a Slight Discord, 1904, p. 6). With the compromise reached, contracts for the construction and equipment of the forge shop were unanimously approved by the City of Buffalo aldermen by the beginning of September 1904. J. C. Watson was awarded a \$1,909 construction contract and Buffalo Forge Company was awarded a \$2,663 equipment contract (Buffalo Common Council, 1904, p. 1977).

Because of Dr. Upton's appeal, high school enrollment in the Technical Course was expected to grow dramatically from about 100 students to about 200-300 students (Manual Training in Our Schools, 1904, p. 12). At the end of the 1904 school year, Major Stowitts, principal of the school, retired and the entire building was turned over to Upton (Principal Upton Elected Head of Normal School, 1909, p. 1). Students younger

than high school age continued to attend classes there for two more years (Daniel Upton is Named Principal, 1909, p. 7).

*2.2.2.1.14 Establishment of a self-contained Buffalo Mechanic Arts/Technical High School.* The school year 1904-1905 was a milestone one for the Technical High School. On September 14, 1904 the dream of the self-contained technical high school that Drs. Upton and Emerson had envisioned was realized. Buffalo's Technical High School, (known as Mechanic Arts High School during 1904-1905), combining industrial training with regular academic courses, was opened in the former School No. 11 as a full-fledged annex to Central High School (Upton D. S., The B. T. H. S., 1907, p. 8).

Emerson said at the beginning of the 1904 school year he:

assigned teachers of high school English and mathematics to School No. 11, where shops and drafting rooms had already been established. The grammar grades in this school had been small for a number of years, and I distributed the children of these grades among the adjacent schools, retaining at No. 11 only the kindergarten and the primaries. The balance of the building has been devoted entirely to the high school work (Emerson, Superintendent's Annual Report, 1905, p. 19).

The kindergarten and primary grades were located on the first floor while the high school was located on the second floor; a single classroom, No. 14, served as an assembly room (A Brief History of the Technical High School, 1912, pp. 29-33).

Sixty-four boys became the inaugural pupils of the Mechanic Arts High School and who only attended it and no other high school. In addition, students of Buffalo's three other high schools (Central, Masten Park, and Lafayette) enrolled in the Technical Course continued to attend Manual Training courses at the Mechanic Arts High School. Dr. Upton was appointed principal of the new high school as well as being in charge of the department of advanced mechanical designing. In addition to Upton, there were four

other teachers who were dedicated to teach classes in English, mathematics, and other academic subjects housed at the school: Mr. H. B. Stoddard (pattern making, joining and wood-turning), Miss Myrtle H. Baker (English), Miss Frances L. Folsom (drawing) and Miss Elizabeth L. Rice (mathematics). Miss Folsom was the first woman Manual Training instructor in Buffalo's Public Schools (*Girls Busy at the Forge and Lathe*, 1906, p. 5).

As previously noted, the Technical High School forge room was completed during the 1904-1905 school year, and officially opened on February 1, 1905. Twenty boys attended forge classes, supervised by Martin J. Quinn (*Mechanic Arts High School*, 1904, p. 6). The accomplishments of the year culminated in the high school's first annual exhibit and sale held on May 19, 1905 (*A Brief History of the Technical High School*, 1912, pp. 29-33). The new forge shop was a main attraction at the exhibit where "in front of the glowing coals the young blacksmiths stood with intent faces heating the iron and then hammering the red-hot metal into shapes" (*Training the Hand and Mind*, 1905, p. 5). While the exhibit and sale is now a relic from the past, students' ability to sell what they made motivated them to attend classes and excel in their studies.

The creation of the new Mechanic Arts High School was attributed to the accomplishments of Dr. Upton (*Mechanic Arts High School*, 1904, p. 6). By the end of the school year, the school was formally renamed Buffalo Technical High School at the suggestion of Mrs. Upton. The school was only one of three in New York State at the time (*Technical High School*, 1905, p. 6).

During the 1905-1906 school year, improvements continued to be made to the Technical High School. In November 1905, the creation of an electrical laboratory was

completed, made possible by the donations of private citizens and business houses (Technical High School is equipped by private Citizens, 1905, p. 16). Also of note during the 1905-1906 year, an annual program was established for cash prizes to be awarded to students for the best categories of work in each technical field. The prizes were funded by private industrial firms in Buffalo (Equipment for Technical High, 1905, p. 34).

There were nine teachers during 1905-1906 who taught the 143 boys and two girls who enrolled. It was noted the two girls “dared” to become co-eds and the girls’ taking Manual Training classes provided an “exciting topic of conversation wherever tech students congregated” (Girls Busy at the Forge and Lathe, 1906, p. 5). In December 1905 the Technical High School received its own charter and was officially recognized by the New York State Board of Regents. Academics continued to be strengthened, with the addition of Rachel R. Marks and Alsa Partridge who taught ancient languages and mathematics (Upton D. S., The B. T. H. S., 1907, p. 8). As in the previous year, the Technical High School had the opportunity to showcase its accomplishments during its second annual sale and exhibit held on June 1, 1906. The sale was visited by 2,200 Buffalonians in what was called “the most remarkable showing ever displayed in a high school” (Two Thousand People Viewed Five Years of Progress at Technical High School, 1906, p. 6).

The next year, 1906-1907, the Technical High School’s registration included 250 boys and four girls, two of whom were the school’s inaugural female students from the previous year (When and How We Started, 1906, pp. 2-3). By the end of the year, a fifth girl had enrolled. The five girls were: Gertrude Dalrymple, May Oakes, Ada Payne,

Juliana Parmelee, and Anna Skilling (Technical High School, 1907, p. 8). Also notable during 1906-1907, all the kindergarten and primary grades were relocated to other schools and the entire building was reserved for the Technical High School (Girls Busy at the Forge and Lathe, 1906, p. 5).

The fourth year of the Technical Course included machine shop practice and the school had to expand yet again to support the curriculum. As early as April 5, 1906 Emerson and Upton appealed to the Buffalo Common Council for an appropriation to build a machine-shop (Additions to the Technical School, 1906, p. 6). Emerson said:

We have already equipped shops for all the mechanical branches except the machine-shop practice and up to this time we have had no need of this shop as the work comes in the later years of the course... Next year, however, we shall have classes in this school which will have reached such a stage in their course that they will require these different lines of work (Buffalo Common Council, 1906, p. 1173).

Emerson's proposal was approved by the Common Council and by the end of the 1906-1907 school year, a \$8,434 one-story brick building containing chemistry and physics laboratories; a lecture/assembly room; and a machine shop was constructed at the Technical High School (Low Bidders for Work at the Technical High School, 1906, p. 7). Other accomplishments that year included the publishing of the school newspaper, the *Techtonian* in December 1906 (First Issue of Techtonian, Technical School's Paper, 1906, p. 5).

It was in the fall of 1906 concerns were discussed about outgrowing the physical confines of the old School No. 11 and the need for a new, larger building. School No. 11, a brick and stone structure, was designed in 1891 by Buffalo architect C.D. Swan to house 800 grammar students and built at a cost of \$58,000 (Real Estate and Building News, 1891, p. 2). While there was nearly universal support for the construction a new

school building, there was much debate about its location (Program of Exercises, 1912, p. 31).

The Technical High School's third annual exhibit and sale was held on May 29, 1907 and it continued to be a popular event that attracted thousands of visitors. Among the dignitaries who attended the event were prominent businessmen, members of the Chamber of Commerce, and leading manufacturers. A highlight of the exhibit was a working model of the first steam engine constructed by the New York Central Railroad and one in which Upton must have had a keenly interest, given his previous steam engine thesis study at Cornell (Great Exhibit at Technical High School Attracted Thousands of Visitors, 1907, p. 4).

The 1906-1907 school year was a pivotal one for the Buffalo Technical High School. At the conclusion of the school year, it produced its first graduates. The significance of the accomplishment was acknowledged when it was noted: "Technical High is now a power among the schools of Buffalo and Mr. Upton has really been the leading spirit in its growth and expansion" (With Hands as Well as Heads, 1907, p. 4). The inaugural class of nine students graduated on June 24, 1907: Louis E. Bleich, Alexander Y. Fotheringham, Carroll Hall, Harold R. Heron, Walter L. Lautz, Edwin Maier, Walter Wanner, Orton E. White, and Myer D. Wolfsohn (Technical High School, 1907, p. 8). The graduation of the nine boys was a crowning achievement for Upton who had worked for over a decade to create a Technical High School for Buffalo. The school had an excellent reputation and was known throughout the United States. Upton said the school was the realization of his beliefs in "a strong mind and a strong body and in the training of both head and hand in the education of the young." The Board of Examiners



said the Technical High School's inaugural class was prepared for "entry into higher institutions for scientific or technical study" (Hickman, 1907, p. 43). A photograph of the nine graduates of the first class of the Buffalo Technical High School is shown in Figure 18.



**Figure 18. First graduating class of Buffalo Technical High School, 1907.**  
*The Tectonian*, 1907.

Upton's influence continued to grow when in November 1907, he was appointed to a prestigious committee on Manual Training and Industrial Education for the State of New York to help in the preparation for a state syllabus in those subjects (Daniel Upton named for an important State Committee, 1907, p. 5).

*2.2.2.1.15 Girls at the Buffalo Technical High School.* The 1907-1908 school year was notable because of swelling enrollment. Registration at the Buffalo Technical High School was so great it received its own annex, at School No. 13 at 278 Oak near Genesee Streets (Technical High School will have an Annex this Year, 1907, p. 17). Ten

girls enrolled that year, which included some who had enrolled the previous year.

Several of the girls transferred from other high schools and one attended Lafayette High School for part of the day (Technical High School Isn't So Slow; Ten Girls at School, 1907, p. 5).

The 1908 graduating class of twelve included three girls: Gertrude Dalrymple, Juliana Parmelee, and Anna Skilling (Ryther, 1908, p. 18). These young women's accomplishments were noteworthy. They pursued technical courses including woodwork and hammering of brass and iron. While Ada Payne was not among the girls who graduated in 1908, she was on the honor roll during both terms of the 1906-1907 school year and was awarded a \$25 prize in June 1907 by the Buffalo Metal Trades' Association for the best metal work during the entire school year (Technical High School, 1907, p. 8).

While the girls studied technical courses traditionally associated with boys, they were also adept at "womanly" arts including the making of candy. One of their instructors, Mr. Stoddard encouraged girls to attend the Technical High School and said its technical courses taught them "self-possession." He went on to explain: "In shop work, they encounter difficulties that their hands must conquer and so they learn to use their heads . . ." Stoddard felt women could make ideal Manual Training teachers: "I would not advise any girl to half-learn it and stop at the hard part. She must learn all there is about it, and at the top there is always room" (Girls Busy at the Forge and Lathe, 1906, p. 5).

Of the four girls who initially enrolled in the 1906-1907 (the three already noted in addition to May Oakes or Ada Payne), three of them hoped after graduation from the Technical High School to study in college and become Manual Training teachers. The

fourth planned her studies so as to include a study of architecture, intending to practice it in the future (Girls Busy at the Forge and Lathe, 1906, p. 5). The three girls who graduated in 1908 were accomplished academically. Dalrymple was named Class Prophet and Parmelee was named Class Testatrix. All of the young women's senior theses were selected for a public reading in May 1908. Dalrymple wrote *Lord Kelvin*, about the work of the famed mathematical physicist and engineer who had passed away a few months earlier in December 1907. Parmelee wrote *Ocean Travel* and Skilling wrote *Essen* (Ryther, 1908, p. 35). Despite the ability of these women to achieve academic excellence in the Technical High School curriculum, in future years the presence of young women would be a rarity. After the initial girls were admitted into the school, admission for girls was suspended for a number of years because of lack of accommodations, and no additional girls were admitted until the opening of the new building (Program of Exercises, 1912, p. 32). Dalrymple remains a bit of a mystery. Although she was identified as a member of the graduating class of 1908 in the *Techtonian*, she was not listed as graduating in the Superintendent's annual report that year. Dalrymple was the daughter of William E. Dalrymple, a prominent manufacturer and president of the Buffalo Gas Mantle Company.

The presence of these three girls in the 1908 graduating class under Dr. Upton is noteworthy. Implied within the scope of Manual Training, although out of scope for this study, are societal gender roles. Girls were typically relegated to what was known in the Victorian era as household arts and later known as home economics, which typically included sewing and cooking. Boys, on the other hand, were taught woodworking and mechanical courses. While Dr. Upton's position on gender roles and diversity will never

be fully known, there is some small telling evidence. At the 1901 convention of the Eastern Manual Training Association held in Buffalo, a paper presented by Miss Lisbeth M. Gladfelter challenged traditional gender roles as they related to Manual Training. Gladfelter asked whether girls should be taught woodworking skills and boys should be taught to cook and sew. After the paper was presented, Dr. Upton remarked most men would say if a girl knew how to conduct her home properly, she had all she needed in the world. However, Dr. Upton added he would allow girls to perform woodworking “while the men were not around” (Vroom, 1901, p. 39). Upton made good on his promise. In 1907, a Buffalo newspaper noted there were women lawyers, women doctors, and women dentists, but these paled to the excitement caused by girls who pursued actual shop labor. For these girls, “no school in Buffalo except the Technical High seems able to provide for the young seekers after knowledge” (Girls Busy at the Forge and Lathe, 1906, p. 5).

In addition to the girls, also noteworthy in the 1908 Technical High School graduating class was Cyril Gordon Ryther, class Valedictorian who received a \$100 prize from Dr. Upton and the Buffalo Chamber of Commerce for the best all-around work. He later returned as teacher at the Buffalo Technical High School and eventually became its principal. While the 1908 graduating class was Technical High’s second, it was the first to complete the full four-year Technical Course at the high school. A photograph of the graduates of the 1908 class with the three young women is shown in Figure 19.



**Figure 19. Second graduating class of Buffalo Technical High School with three female graduates, 1908. *The Tectonian*, 1908.**

*2.2.2.1.16 A new building needed for the Buffalo Technical High School.* By 1908, the demand for a new school building reached a zenith. Because of Dr. Upton's leadership, the school was so successful the Buffalo Public School board authorized the construction of a new Technical High School that would feature contemporary design concepts and the newest equipment possible. In the summer of 1908 Upton traveled to England and Germany to research successful European technical schools to inspire plans for a new building in Buffalo. The Buffalo Technical High School, constructed at 333 Clinton Street, was patterned after the Technical High School in Dublin, Ireland (Englebreck, 1946, p. 89). By July 1909, a Buffalo architect, Martin C. Miller, was selected and plans were completed for a new school to cost about \$411,000 (Plans for the New Technical High School, 1909, p. 3). Construction began on April 15, 1912; the building's corner stone was laid on November 14, 1912 and it opened on September 8, 1914. The new Technical High School was designed with 190 rooms with a combined

capacity to seat 1,326 students. Final construction cost was \$650,000 (University of the State of New York Division of Educational Facilities Planning, 1917, p. 260). Fitting for its status as Buffalo's Technical High School, it was Buffalo's only school to produce its own electricity by means of steam boilers (Weed, 2001, p. 32).

While Dr. Upton had left the Technical High School by the time its new cornerstone was laid, his contributions were not forgotten. During the cornerstone laying ceremony, it was noted:

Little did Daniel Upton realize when he entered upon his work in this city eighteen years ago, as a teacher of drawing and manual training, that the seed which he dropped would bring forth this great tree of possible knowledge and training. His work so well begun has extended to represent every plan of industrial education – intermediate vocational schools – evening trade courses – home making courses, and girls' industrial schools (Dean, 1912, p. 19).

At the time of the opening of the new school building, attendance was 869 boys and 155 girls. If Upton would have allowed girls to engage in a "little woodworking," his successor would have none of it. Arthur S. Hurrell, principal of the Technical High School from 1909 until 1916, said it was "foolish" for girls take the same courses as boys. He said while girls and boys at the Technical High School would take similar subjects, such as chemistry, the teaching of them would be very different. For girls, chemistry would be taught from the "home" perspective, while boys would be taught chemistry from a "severely technical" perspective (Economics of the Home, 1911, p. 6). At the dedication address of the new Technical High School's cornerstone in November 1912, Dr. Arthur D. Dean, Chief of the Division of Vocational Schools for the New York State Education Department in Albany New York clearly articulated his vision for girls when he said:

The aim of the vocational and trade courses for girls is twofold: First, to enable them through the right sort of homemaking training to enter homes of their own and assume household duties intelligently, perpetuating the type of home that will bring about the highest standard of health and morals; second, to train, by means of courses of trade instruction, for work in distinctly feminine occupations (Dean, 1912, pp. 18-19).

Girls were once again denied attendance altogether to the Technical High School during the mid-1930s. In 1935, no freshman girls were being accepted and there were no classes for them beginning in 1938 (Fess, 1952, p. 19).

The Buffalo Technical School operated out of the Clinton Street building for 40 years until it was moved to Hutchinson Central High School on Elmwood Avenue in 1954. The former building was then used as Clinton Jr. High School and then converted into the Buffalo Academy for the Visual and Performing Arts (BAVPA) in 1976 (Weed, 2001, p. 32). After BAVPA moved to a new Masten Avenue location, the former Buffalo Technical High School building was utilized as a swing school during the City of Buffalo's reconstruction project.

*2.2.2.1.17 Upton's plea for Manual Training education at the Buffalo Normal School.* As Upton achieved his success of the creation of Buffalo Technical High School, it would be only natural he would consider the needs of training teachers for Manual Arts. By the middle of the twentieth century's first decade, the Buffalo Normal School had no program to educate teachers in Manual Training methods, despite outcries for the need of such a program. Upton added his voice to the chorus when in June 1906 he addressed the students at the Buffalo Normal School on the topic of Technical and Industrial Education in the United States. Also addressing the students was Professor Willis Graves, New York State inspector of training schools. At the address, Upton stressed the practical results of the efficiency of local Manual Training efforts, proving

the worth of technical schools in Buffalo (Importance of Industrial Training in the Schools, 1906, p. 5).

Perhaps because of Dr. Upton's prompting, in the school year 1906-1907 a few Manual Training classes were introduced into the Buffalo Normal School (Senior Class of the Buffalo Normal School, 1922, p. 17). Although the Vocational Industrial Department wouldn't be officially started until 1910, Buffalo State College traces the origin of its Industrial Arts department to 1906 (Buffalo State College, 2011). It is likely the Manual Training instruction for teachers that existed at Buffalo State during the four years from 1906-1910 was closer to Household Arts than Industrial Arts. Methods in Manual Training might have included paper-folding, drawing form study, clay modeling, or sewing. It is known there was no workroom at Buffalo State during that period.

The classes were taught by Georgina E. Chamot (1856 - 1934), who was hired on August 18, 1897 to teach the French language and literature at the Buffalo Normal School. Her starting salary was \$350 annually (compared with the principal's salary of \$3,000) (NYS Department of Civil Service, 1899, p. 770). Miss Chamot, the daughter of Christopher P. Chamot, a well-known French shoe manufacturer, came from a teaching family, who were longtime residents of Buffalo's Johnson Park. Georgina's two sisters, Eugenie L. and Lydie A., were also teachers (Lydie was also a faculty member at Buffalo State, being a teacher of the German language). It was noted the "Misses Chamot are teachers of reputation in the City of Buffalo" (New York State Assembly, 1899, p. 156). Georgina Chamot, along with her sister Eugenie were 1876 graduates of the Buffalo Normal School's classical course (Buffalo Normal School, 1876, p. 4). Georgina later attended two summer sessions at both Columbia and Cornell Universities (Senior Class



of the Buffalo Normal School, 1919). Because of Chamot's duties teaching Manual Training, in 1906 the Buffalo State Local Board of Trustees voted to increase her annual salary from \$500 to \$700 (Buffalo State Normal School Board of Trustees, 1906). While Chamot taught Manual Training at Buffalo State, she also continued to teach French (University of the State of New York, 1908, p. 213). While there are no conclusive records the researcher has discovered which disclose what Manual Training classes Chamot taught from 1906-1910, it is perhaps telling that when the Buffalo Normal School's Household Arts Department was formed in September 1910, Chamot was assigned to the department and was responsible for clothing work (Senior Class of the Buffalo Normal School, 1922, p. 25). In later years, Chamot taught domestic arts and sewing (Senior Class of the Buffalo Normal School, 1912, p. 2).

Whether the origins of Buffalo State's Industrial Arts program can be traced to the Vocational Industrial program of 1910 or Miss Chamot's classes of 1906-1910, there is evidence of the genesis of such classes at Buffalo State many years earlier. In 1890 Dr. James M. Cassety, principal of the Normal School, stated he endorsed applied learning and practical experiments. Work with electricity had already begun, including the installation of a dynamo. Cassety noted with pride the accomplishment of one of the Normal School's students, Mr. Babcock, who made a mannequin that moved by electricity (Some Practical Sciences. The Study of Electricity at the City Schools--Original Work at the Normal., 1890, p. 7).

*2.2.2.1.18 Upton becomes principal of the Buffalo Normal School.* In 1909 planning work to build the new Buffalo Technical High School for which Dr. Upton had worked so diligently had begun. However, an event occurred that same year that would

ultimately signal a change in Upton's career: Dr. Cassety, who had been principal of the Buffalo Normal School for 23 years, resigned on June 23, 1909 at the end of the school year (Wofford, 1946, p. 89).

Meanwhile, Dr. Upton's prominence as an educator continued to grow at a national level. By 1909, The Eastern Art Teachers' Association had merged with the Eastern Manual Training Association (of which Upton had been president in 1902). On May 8, 1909, Dr. Upton addressed the combined organization's annual meeting held that year in Pittsburg, Pennsylvania with a paper entitled *Elementary Manual Training is Necessary in the New Industrial Education*. In his address, Dr. Upton seemed prophetic in predicting changes that were coming to the United States:

There is no doubt whatever that if this country is to continue to enjoy industrial supremacy, or even industrial freedom for that matter, with such highly organized and trained countries as Germany and Japan seeking the same markets and with that drowsy giant, China, of unknown capacity, beginning to bestir herself under the influences of modern progress, we must begin a systematic conservation of the energies of our workmen as well as our natural resources . . . I firmly believe that with the next two decades this country will enter a great struggle for its industrial life (Upton D. S., *Elementary Manual Training is Necessary in the New Industrial Education*, 1910, pp. 279-280).

Upton was very concerned for America's industrial health and couldn't have said it more plainly when he cautioned foreign countries are "not only copying our methods but by giving technical instruction to their future workmen, and if we neglect this latter feature we shall be giving a large advantage to our competitors. The race in the long run will be to the nation whose average intelligence is highest" (Upton D. S., *Report of the Director of Manual Training*, 1903, p. 76).

Upton extolled the value of an industrial arts education as "if properly presented [a student will] develop not only the observational and rational powers and dexterity, but

... a love for doing and an appreciation of those who can do” (Upton D. S., Elementary Manual Training is Necessary in the New Industrial Education, 1910, p. 282).

The same summer in which Upton gave his address, Andrew S. Draper, Commissioner of Education for the State of New York, Edward H. Butler and New York State Senator Henry W. Hill of the Buffalo Normal School’s local board began a search for the best candidate to lead the Buffalo Normal School and to initiate new departments in Household Arts (later known as Homemaking) and Vocational Industrial Education. Commissioner Draper said he had a particular interest in Manual Training and the progress it has made in the educational world. Draper also said he had a vision of developing a manual training course in the Buffalo Normal School (For Normal School State Superintendent has Decided Views Regarding Local Institution, 1909, p. 9).

Three candidates were considered to head the Buffalo Normal School: Marcus A.G. Meads, Columbus N. Millard, and Daniel S. Upton. Its Local Board initially nominated Marcus A.G. Meads, a professor of mathematics and astronomy who had been a successful instructor at Buffalo State for many years. Millard was supervisor of grammar grades in the City of Buffalo Public Schools. At a meeting of the Local Board on June 23, 1909, the board resolved “that it is the judgment of the Board of Managers of the State Normal School of Buffalo, N.Y. that Professor M.A.G. Meads be recommended for appointment as superintendent of the State Normal School at Buffalo, and, that the Commissioner of Education be so notified” (Buffalo State Normal School Board of Managers, 1909).

Upton was not seeking the job, but his name was put forth by persons who were “anxious to increase the efficiency” of the Buffalo State Normal School (For Normal

School State Superintendent has Decided Views Regarding Local Institution, 1909, p. 9). Despite the Local Board's recommendation, Commissioner Draper stated he preferred a younger man and the Local Board complied with Draper's recommendation. The new Buffalo Normal School principal was envisioned to be a "young, aggressive, original and successful educator." As reported in a contemporary *Buffalo Commercial Advertiser* article, Upton met these qualifications because of the work he had accomplished at the Buffalo Technical High School, a "school which has made a wonderful growth and attained great success in comparatively few years under the direction of Mr. Upton" (Three After It, 1909, p. 15). Draper wrote a letter to the Local Board in which he disapproved of its nomination of Professor Meads for principal. The Local Board met on July 23, 1909 and made a motion that Daniel Upton be nominated as successor to Dr. Cassety and submitted to the New York State Commissioner of Education for approval (Buffalo State Normal School Local Board of Managers, 1909). With Commissioner Draper's approval, Dr. Upton was then appointed principal on July 23, 1909 and confirmed at the meeting of the Buffalo Normal School Local Board of Trustees on July 30, 1909 (Finegan, 1917, p. 221). Of the appointment, Edward H. Butler, president of the Local Board, said Upton's "qualifications are of the best" (Daniel Upton is Named Principal, 1909, p. 7). Dr. Upton was chosen for the position of Buffalo Normal School principal because of his outstanding success as leader of Buffalo's Technical High School (Englebreck, 1946, p. 50).

Perhaps no greater acknowledgement could have been paid to Dr. Upton on his new position than the tribute made by the prestigious *Manual Training Magazine*, edited

by Charles A. Bennett and William T. Bawden (who worked with Upton in the late 1890s). It was noted:

Daniel Upton, who organized manual training in Buffalo over fifteen years ago, and under whose care the Department of Manual Training has grown from one grammar school shop to thirty-nine grammar school shops, equipped for woodworking, one vocational school and a technical high school, has gone to a larger field as principal of the Buffalo State Normal School (Bennett C. A., 1909, p. 177).

When Dr. Upton became principal of the Buffalo Normal School, he received an annual salary of \$3,500 (his salary as principal of the Technical High School was \$2,500). In addition to the salary received at the Normal School, an additional benefit of the job was exclusive use of the principal's residence, a brick manse at 110 Fourteenth Street at the corner of York Street on the school lot, described as a "modern and valuable building" (Three After It, 1909, p. 15). Creation of the house was authorized by the New York State legislature in 1889. Plans were prepared, but its construction was not funded until 1893. In autumn that same year, construction on the house began and it was completed in 1894 at a cost of \$10,000 (Senior Class of the State Teachers College at Buffalo, 1931, p. 14). The two and one-half story home was roughly 38 feet wide by 50 feet long, prominently sited on a raised lot and foundation. The home had a front porch that wrapped around to York Street. The house sat about 50 feet from the curb and had a brick walkway that led from the sidewalk to the front porch. The home had a projecting bay window on the south side and a wrought iron fence ran along both Fourteenth and York Streets. The house was demolished in 1958 when an addition with pool was constructed at Grover Cleveland High School (Napora, 2011).

Upton made an immediate positive impression at the Buffalo State Normal School. In December 1909, Upton gave an entertaining stereopticon lecture for the

school's students and their friends. At the end of the lecture, the hall was cleared for dancing. Upton was described as being "immensely" popular with both the students and teachers because of his sincere interest in their welfare, happiness, and his progressive ideas on education (Doing Much for the State Normal School, 1909, p. 4).

Dr. Upton did have challenges at the Buffalo Normal School. In 1909, the Normal School's enrollment had dropped substantially because of a ruling of the State Department of Education which placed all normal schools on a professional basis and made the completion of a four-year academic course as a prerequisite for admission (Wofford, 1946, p. 44).



**Figure 20. Dr. Daniel Sherman Upton while Principal of the Buffalo Normal School, 1909-1918. Buffalo State College Archives. The facsimile of Upton's signature is from a 1915 *Elms*.**

#### ***2.2.2.2 Creation of Buffalo State College Vocational Industrial Department.***

With Dr. Upton at the helm, rapid changes were in store for the Buffalo Normal School. A photograph of Dr. Upton while principal of the Buffalo Normal School is shown in Figure 20. Even before Upton officially became principal, he announced changes to the curricula at the Buffalo Normal School, declaring he would “add new branches in the already excellent courses of study,” that would be “progressive, though soundly conservative” (Principal Upton has Normal School Plans, 1909, p. 9). Upton delivered

on his promise with the creation of new departments such as the Household Arts (later Homemaking) department.

For the purpose of this study, Upton's most significant impact was when he initiated the Buffalo Normal School's Vocational Industrial department in September 1910 as a branch of the normal program and when Manual Training was introduced into the School of Practice (Wofford, 1946, p. 49). The Buffalo Normal Vocational Industrial program would undergo many changes during the first ten years of its existence as a result of the program's infancy, changing faculty, maturity of the New York State vocational curricula, and sweeping world economic and political changes as a result of World War I.

#### *2.2.2.2.1 Creation of the Buffalo Normal School Vocational Industrial Program.*

The Buffalo State Normal School's Vocational Industrial program began on September 14, 1910 with an evening class of six men (State Normal and Training School, 1910). The program was designed to appeal to a mechanic who was employed during the day and with proper training could be developed into a teacher (Senior Class of the Buffalo Normal School, 1914, p. 44).

In the Buffalo Normal School's 1910 *Circular of Information*, the program was simply titled "Normal Courses in Industrial and Domestic Arts and Sciences." Classes consisted of those held at the school as well as practice in shops (in essence, an internship). For the industrial program, courses offered included: Mechanical Drawing, Machine Shop Practice, Joinery and Cabinet Work, and Pattern Making (State Normal and Training School, 1910, p. 9). As was the case for all New York State residents,



tuition and the use of text books was free for students (State Normal and Training School Circular of Information 1911-1912, 1911, p. 7).

While the program had humble origins, it had lofty ambitions. Upton noted the Buffalo State program was, to the best of his knowledge, the first of its kind in the United States to approach industrial education in such a broad way. Upton said:

We expect a great deal from this course and while at first we will not have the equipment necessary to give us the standing of an institution like the [Albany] Teachers College, for example, we intend to have this branch of the normal training developed until our school will stand second to no industrial educational institution in the country. We intend to get the very best teachers obtainable for each course and we hope to make this a big thing for the boys and girls of Western New York (Changes at the Normal, 1910, p. 5).

The program was described as being the first time in the history of any New York State normal school that courses in Industrial Education would be offered (Industrial Education, 1910).

The new Vocational Industrial program inaugurated at Buffalo State was put under the charge of Harrison C. Givens, its program director from 1910-1915. Givens was also given the title of principal of the Vocational Department (Senior Class of the Buffalo Normal School, 1915). Givens, who had a Mechanical Engineering degree and a Bachelor of Science degree in education, was hired at Buffalo State on September 1, 1910 at a salary of \$1,800 (New York State Department of Civil Service, 1911, p. 224). Under Upton and Givens' leadership, Buffalo State's Vocational Industrial program was soon receiving wide recognition. In 1913, Dr. A.C. Thompson, principal of the State Normal School at Brockport said:

The movement toward vocational work in the public schools of the State has proven itself of such value that the State is now training teachers for that work alone. The Buffalo State Normal School of Buffalo is the

pioneer of all normal schools in this class of work. With an efficient staff of instructors, under the supervision of Mr. H.C. Givens, the school is doing great work . . . It is not the purpose of vocational schools to turn out finished tradesmen, but to give the boy a foundation of mechanical knowledge after he has decided upon his life's work; the school helps him make his decision (Wheeler, 1913, p. 27).

The Vocational Industrial program at Buffalo State started with virtually no facilities and the inaugural class was required to construct their own workroom in the basement of the original Buffalo Normal School. They were described as pioneers who had “energy and courage . . . and have overcome many obstacles” to make the Buffalo Normal School’s Vocational Industrial program a reality (Senior Class of the Buffalo Normal School, 1912, p. 41).

*2.2.2.2 Upton inaugurates athletics at Buffalo Normal School, popular with Vocational Industrial program students.* Upton and the Vocational Industrial program had one other immediate impact to the Buffalo Normal School: the introduction of athletics. Just a few months after Upton took the helm of Buffalo State, it was noted “the Normal School has never given much attention to the subject of athletics, but considerable interest has been aroused of late by Mr. Upton” (Doing Much for the State Normal School, 1909, p. 4). Upton envisioned a modern and well equipped gymnasium and in 1910 tennis courts were constructed for the school’s students. Competitive men’s athletics were introduced at Buffalo State when a basketball team was organized, primarily comprised of Vocational Industrial students, shortly after 1910 (Wofford, 1946, p. 126). The team quickly became a fixture in the school as they scored many victories against various area high-schools and colleges (Senior Class of the Buffalo Normal School, 1912, p. 41). A photograph of its 1911-1912 basketball team is shown in Figure 21.



**Figure 21. 1911-1912 Buffalo Normal School basketball team. Russell Newell Keppel, 1913 class president and 1914 graduate of the Vocational Industrial program, is the rightmost seated man in the second row. The man seated to the left, next to the manager in the suit, is Raymond Pratt Krull, a member of the Industrial program's first graduating class of 1912. 1912 Elms.**

*2.2.2.2.3 New York State standardizes Vocational Industrial Program.* In 1911 the New York State Education Department abolished its old Manual Training and drawing courses and established a new, standardized Industrial Arts/Vocational Industrial Education two-year course (Bennett C. A., 1937, p. 476). At Buffalo State, the Vocational Industrial program proved to be popular. Both a day and evening class was instituted; the day class was two years in length while the evening class was three years in length. Of the six men who initially enrolled in the evening program in 1910-1911, five completed the first year's studies and four returned for the 1911-1912 school year. In addition, there were thirty-two new evening students enrolled in the program. In the day program, nine students enrolled during the 1911-1912 school year. All Vocational Industrial students worked part-time in factories while they attended school and practiced

teaching in school shops or better-equipped settlement houses (New York State Education Department, 1912, p. 419).

The Normal Course in Vocational Industrial Training was designed to provide training for teachers of the industrial branches and was comprised of practical laboratory, shop and drawing room experience. The 1911 New York State program included 650 hours of instruction in general education; 700 hours in professional education; and 1,050 hours in technical courses including joinery and cabinet making; wood turning; pattern making; art metal; machine shop practice and tool making; printing; bookbinding; molding; and forging (Rogers, 1961, p. 98).

At Buffalo State, in 1911, in addition to vocational subjects, general education courses teachers were required to study included English, history, mathematics, science, and a foreign language. These classes were modified to focus on vocational education topics. For example, mathematics courses focused on problems in joinery and building construction, foundry work, pattern making and machine shop practice. Science courses focused on the fundamental principles of mechanics, power transmission, prime movers, etc. The level of integration of non-vocational subjects into the Vocational Industrial program was debated during the formative years of the program. However, an assessment prepared by Givens in 1910 of opinions of three groups (employers, organized labor, and education) showed that beyond specialized vocational education, it was beneficial for students to attend classes in drawing, science, mathematics, English, history, and limited geography. However, it was Givens' opinion that specific vocational education should be grouped by tools and processes (as opposed to similarity of materials) and thus grouped, each would have their distinct non-vocational subjects

taught to them in an applied way. Givens said “I believe [non-vocational subjects will be] more easily mastered since the pupil sees their immediate application. Later, if time permitted, a broader application of general principles learned in any subject could be introduced” (Givens, 1911, p. 278).

Upon successful completion of the Vocational Industrial program and meeting other requirements of the Buffalo Normal School, graduates were awarded a New York State teaching diploma that permitted them to teach Vocational Industrial subjects in any school in New York State (State Normal and Training School Circular of Information 1911-1912, 1911, pp. 9-14). Although the educational requirements of both the day and evening Vocational Industrial programs were identical, the day class included two years of full-time instruction while the evening class included three years of part-time instruction, meeting three times each week (Senior Class of the Buffalo Normal School, 1915). On Wednesday evenings, the class studied psychology, English, and teaching methods; the other two nights each week were spent in practice, teaching and observation (Wheeler, 1913, p. 28). Dr. Upton, even though principal of the Normal School, continued to take an active hand in the Vocational Industrial program. He taught the mechanical drawing class himself on Friday evenings (Grabau, Vocational, 1914, p. 33).

Interestingly, the New York State Education Department noted the experience at the Buffalo Normal School indicates:

abstract subjects in the courses of study for these prospective teachers, such as psychology and history of education, are not desirable and that practically all the efforts now given to these lines should be directed toward planning courses of work and equipment; to developing the art of teaching industrial subjects; and to the giving of instruction in shop mathematics, electricity and mechanics which are intimately connected with the trade instruction (New York State Education Department, 1912, p. 419).

While the Vocational Industrial program was designed for only two years of full day-time study, the total number of required hours for instruction in the subject area was 2,500, similar to the number of hours of study required for a modern baccalaureate degree (State Normal and Training School Circular of Information 1911-1912, 1911, pp. 12-13). The program's required subject areas and number of hours of study is shown in Table 3.

**Table 3. Subject Areas Required at Buffalo Normal School Vocational Industrial Program.**

<b>Buffalo Normal School Vocational Education Subject area</b>	<b>Hours</b>
History and Principles of Education	100
Psychology	100
Methods in Arithmetic	40
Methods in Science	120
Methods in Shop Instruction	300
Drawing and Design	240
Shop Work (Joinery and Cabinet Making; Pattern Making; Machine Shop Practice, Mechanical Drawing; or Printing)	1,200
Teaching	400
<i>Total</i>	2,500

*2.2.2.2.4 Buffalo Normal School Vocational Industrial Program produces its first graduates.* The inaugural Buffalo Normal School Vocational Industrial education class of six students graduated on June 18, 1912: George E. Gannon, John W. Henderson, Carl R. Kraus, Raymond Pratt Krull, Clifford B. Smith, and Anthony K. Zientowski. Gannon served as officer of the graduating class as secretary (Normal School Commencement Tonight, 1912, p. 15). Although it was an evening three-year program, its members graduated earlier as some were already employed as teachers. It is likely that four members of the inaugural graduating class were enrolled in 1910-1911 and two students enrolled in 1911-1912.

In 1912, Upton was proud of the state of the Vocational Industrial program and attempted to differentiate it from Manual Training. He said: "Vocational work has in most places had manual training as its forerunner and the methods of securing teachers

for the latter work has too frequently been to call in a handy janitor or some skilled workman and trust to his being able to impart his craft to the classes, or there has been selected one of the regular teachers who may have made a Morris chair or a hall clock and he has been sent to the shop with the hope that he might be able to keep ahead of his class in his training as a cabinet maker.” Upton continued and explained the objective of the new program:

It was with the intention of producing teachers who would be competent in both the pedagogical and mechanical requirements that the New York State Education Department and the Local Board of Managers authorized courses in Normal Vocational Training ant Buffalo’s State Normal School. The Department of Vocational Training provides normal instruction in any of the recognized trades . . . The school takes such a skilled workman and gives him a training in the methods and principles of teaching the trade which he possesses . . . provision is made whereby [students] may have part-time instruction in the school and part-time at work in ships or factories of the city.

While the program was specifically designed to prepare teachers in schools,

Upton had further ambitions for the program:

While expecting that the graduates from these vocational classes will be largely employed to each in public or endowed schools, another field seems likely to open. Shop economics is today one of the great industrial features and in the scheme the workman must be considered. There seems no reason to doubt that along with the systematizer will eventually come a person whose function will be to bring the working force up to the highest possible degree of efficiency through shop lectures and the instruction of individual workmen; and for such a position the combination of workman and teacher will be essential (Upton D. S., Normal Vocational Training at the Buffalo State Normal School, 1912, pp. 35-36).

#### *2.2.2.2.5 Upton receives doctorate and promotes the growth of Buffalo Normal*

*School’s Vocational Industrial Program.* In addition to Dr. Upton’s responsibilities as principal of the Buffalo Normal School, he continued to find time to promote industrial education in general. The most important of these was Upton’s participation in the

National Society for the Promotion of Industrial Education, organized in 1906. One of its founders was Charles R. Richards. The organization was created with the intention to promote passage of federal legislation to support vocational education, resulting in the Smith-Hughes Act (Hillison, 1995, p. 4).

On February 24, 1912 the annual convention of the New York State Branch of the National Society for the Promotion of Industrial Education was held in Buffalo at the Hotel Statler. Mr. Charles Rohlf, the famed furniture designer, was the introductory speaker and said “the efficient man or woman worker of today is the man or woman whose efficiency is based on a thoroughly co-ordinated mental and manual training.” At the convention, Dr. Upton was elected president of the New York State Branch for 1912-1913 (Vocational Education, 1912, pp. 48, 54). Upton and Rohlf likely knew each other and may have even lived in the same elegant boarding house together: Rohlf lived at 10 Orton Place between July 1896 and May of 1898 and Upton lived there sometime between July 1897 and May of 1899. Upton presided at the next annual convention of the New York State Branch of the National Society for the Promotion of Industrial Education held in Syracuse on March 8, 1913 (Educators Urge Trade Schools, 1913).

1912 also marked an important milestone in Upton’s own academic achievements. As he worked, he continued his educational pursuits. In 1891, Upton completed his studies at Olivet College and received his Bachelor of Science degree. In 1912, the New York State Normal College at Albany conferred upon him the honorary degree of Doctor of Pedagogy (Pd.D.) in recognition of his educational achievements. The commencement ceremony was held on June 18, 1912 at the College auditorium (New York State Normal College at Albany, 1912, p. 707). In conferring the degree,



President Milne of Albany Normal College referred to Upton's excellence of his work (Receives Degree of Doctor of Pedagogy from Normal College, 1912, p. 21)

Each year, the Buffalo Normal School's Vocational Industrial program continued to grow. The graduating class of 1913 included 15 students (Senior Class of the Buffalo Normal School, 1913, p. 62); only one of which was a day student (State Normal and Training School Circular of Information 1911-1912, 1911, p. 29). The graduating class of 1914 included 24 students, eight of which were day students (Senior Class of the Buffalo Normal School, 1914, p. 32). For the evening students, the graduating class of 1914 was the first that completed the three years' study required for graduation. Some of the earlier classes graduated in less than three years because they were already employed as teachers and finished their course work early (Senior Class of the Buffalo Normal School, 1914, pp. 43-44).

*2.2.2.2.6 Vocational schools open in Buffalo and enhance need for Normal School's Vocational Industrial Program.* The popularity of the Vocational Industrial program at the Buffalo Normal School may have been bolstered by the rise of vocational schools in Buffalo and nationwide. In Buffalo, the Technical High School was already established and in September 1909, the city's first vocational school was opened: Seneca Vocational. In September 1910 three additional Buffalo vocational schools were opened: Black Rock, Broadway, and Rother Avenue. In September 1911, a fifth, the Peckham Street Vocational School, was opened. During the 1911-1912 school year, vocational school enrollment was 562 boys with 20 instructors. It was proudly noted "Buffalo is doing more vocational work than any other city of the United States." (Vocational Schools of Buffalo, October 27, 1911). In addition, there was continued support for

additional vocational schools because of the supposed benefits they provided to a changing post-Victorian American society. Influential Charles Rohlfs said:

To avoid raising useless men and women our vocational school steps in and helps the boys and girls to find themselves, teaches them to value excellence and exactness, makes them self-reliant and respectful, helps them to discover in the shortest possible time the work in which they can excel and consequently, the work that in the doing, makes them happy.

With all this comes the sense that it is dignified and ennobling to work at what is satisfactory. This brings with it a sense of duty. It strengthens character and makes one look out cheerfully upon life.

To the girls who are taught domestic science, the work of the kitchen is not drudgery, for what she does, she does understandingly, knowing how to commence and just where and how to finish. Even dish-washing can be done in a way to rob it of its terrors, if you know how (Rohlfs, 1911, p. 80).

During this early period of the Buffalo State Vocational Industrial program, continued outreach by Buffalo State helped to bolster the program's reputation. On May 9, 1914, Givens gave an illustrated talk entitled *Shop Methods* at the New York State Vocational Conference held in Syracuse (50 Vocational Teachers Meet, 1914, p. 3).

*2.2.2.2.7 Buffalo Normal School's Vocational Industrial Program made evening-only program.* The Buffalo Normal Vocational Industrial day class of 1914-15 was the program's last and students were merged into the evening class the following year (Senior Class of the Buffalo Normal School, 1915). The Buffalo Normal School's official curricular offered this explanation for the termination of the Vocational Industrial day program:

The authorities of this school believe that the man who is a thorough master of a trade is most likely to prove a successful teacher of that trade or of the book subjects connected with it. Appreciating that ordinarily such a man would be employed as a wage earner during the day, the Buffalo State Normal School conducts its Normal Vocational classes for these groups in evenings (State Normal and Training School, 1915, p. 16).

Another significant change occurred to the program during the 1914-1915 school year. The program was divided into two courses: the Trade Group (Course A) and the Bookwork Group (Course B). The Trade Group was focused on teaching the trades themselves, while the Bookwork Group was focused on “providing a knowledge of the fundamental principles and technical terms common in industrial lines including applied science, industrial geography, history, math, etc., that is correlated with the handwork in the best types of vocational schools” (State Normal and Training School, 1914, p. 10). The two separate courses were offered through the 1917-1918 school year.

By 1915, Vocational Industrial classes were expanded to include, besides those already mentioned, these additional vocations: industrial design; mechanical and architectural drafting; electrical construction; foundry; plumbing; carriage body making; decorating and wood finishing; blacksmithing; and masonry (State Normal and Training School Circular of Information 1911-1912, 1911, p. 29).

*2.2.2.2.8 Buffalo Normal School's Vocational Industrial Program notable alumni, including its first female graduate.* There was one other unusual vocation added to the program by 1915: dressmaking. Prior to 1920 there was only one vocational dressmaking student, a woman named Anna H. Boyd. This was likely due to a minor distinction between the Household Arts and Vocational programs. The Household Arts program included combined studies in three core areas: cooking, sewing, and millinery (State Normal and Training School, 1911, p. 15). Yet the Vocational Industrial program included 1,200 hours of work in a single vocational discipline. Prior to 1920, Anna Boyd was the only female Vocational Industrial student who studied vocational dressmaking, likely under teacher Georgina Chamot. Beginning in 1920 vocational dressmaking

women returned to the program with approximately ten women each year. The increase of vocational dressmaking students can be attributed to the reorganization of the Household Arts department into the Homemaking Department and the hiring of a dedicated vocational dressmaking instructor, Mrs. Elizabeth P. Taylor, who taught at the Buffalo Normal School during 1920 – 1926. Taylor came to Buffalo after being in charge of the costume shop at McCardy & Company store in Rochester. Taylor brought her retail experience to the Buffalo Normal with the opening of the Garment Shoppe, a commercial outlet to provide a larger opportunity for experience and training in costume design and clothing construction (Senior Class of the Buffalo Normal School, 1922, p. 27). After leaving the Buffalo Normal School, Taylor returned to Rochester where she taught dressmaking at the Rochester Mechanics Institute (New Teachers to Join Staff at Mechanics, 1926). While the vocational dressmaking graduates were included in the Vocational Industrial program, Chamot and Taylor were part of the Household Arts or Vocational Homemaking Department (State Normal and Training School, 1926, p. 7).

Despite the many changes in faculty and curricula, the Buffalo Normal School's Vocational Industrial program was very successful and continued to grow. Many graduates of the program developed significant teaching careers. R. Pratt Krull is particularly noteworthy because of his long association with Dr. Upton. Krull enrolled in the Technical High School in 1906 while Dr. Upton was principal. During the 1908-1909 school year, the last year that Dr. Upton was principal of the Technical High School, Krull was elected president of its Junior class. As president, Krull was responsible for fifth annual Technical High School exhibit and sale on May 14, 1909 and its Junior Day program held on June 4, 1909 (Technical High School, 1909, pp. 12-14). These events,

especially the exhibit and sale, were very important to the school and Dr. Upton was heavily involved in both. The annual exhibit and sale was a Buffalo highlight that attracted over 2,000 visitors. While Mr. Krull graduated from the Technical High School in 1910, the year after Dr. Upton left, Krull followed Dr. Upton to the Buffalo State Normal School and became one of the inaugural students of its new Vocational Industrial program in autumn 1910. As such, he was a member of the Buffalo Normal School's Vocational Industrial first graduating class of 1912. At class day exercises held June 17, 1912, Krull read the senior class prophecy (Normal School Commencement Tonight, 1912, p. 15). Mr. Krull continued his education and went on to earn a Master's degree from the University of Buffalo. He began his career immediately after graduation from the Buffalo Normal School when he became an Industrial Arts teacher at School No. 1 at 349 Busti Avenue in 1912. In 1917 Mr. Krull became assistant director of Manual Training in the Buffalo Public Schools. He later became assistant superintendent for extension education, school-community relations, and business and plant services. Mr. Krull ended his career as deputy superintendent of business and plant services and was influential in planning the construction of 39 new schools and 45 major additions to existing schools (Services Are Held For R. Pratt Krull, Retired School Aide, 1970, p. C8). A photograph of Krull, as member of the 1912-1912 Buffalo Normal School basketball team, is shown in Figure 21.

Mr. Zientowski, another of the six original graduates, taught school for 33 years in Buffalo at schools 26, 47, 57 and 58 (Anthony K. Zientowski, 1969, p. 22). Another example of the value of the early graduates of the program is Russell Newell Keppel (1892 – 1968). Keppel graduated from the normal program in 1913 and was named

Buffalo Normal School class president that year (Senior Class of the Buffalo Normal School, 1913). In his president's address, Keppel said "There are other types of schools which have been established to meet the needs of progress. One of these which has been evolved from experience and has received the stamp of approval is the vocational school... in the vocational schools [children] may be trained for a more efficient life. Here the pupils not only receive an academic training but also an excellent foundation for future vocation" (Senior Class of the Buffalo Normal School, 1913, p. 28). Keppel returned to the Buffalo Normal School the next year and graduated from its Vocational Industrial day class in 1914 (Senior Class of the Buffalo Normal School, 1914, p. 32). A photograph of Keppel, as member of the 1912-1912 Buffalo Normal School basketball team, is shown in Figure 21.

Another notable individual associated with the Buffalo Normal School Vocational Industrial program was Andrew W. Grabau (1895 - 1974), the 1915 Normal School class president (Senior Class of the Buffalo Normal School, 1915). After serving in the army during World War I, in 1925 Grabau returned to the Buffalo State Normal to teach English and Industrial Psychology within its Vocational Industrial Department (Senior Class of the State Normal School Buffalo New York, 1926, p. 17). As a student, Grabau was captain of the Normal School's basketball team from 1913-1915 and became school coach for basketball, tennis and baseball when he returned to teach. Grabau retired from Buffalo State in 1959 and received the College's Centennial Distinguished Service Award during the school's centennial ceremony, September 19, 1971 (Andrew W. Grabau, BSUC Professor, 1974, p. 42). In 1972, he was honored by the college's Alumni Association for distinguished service and was honored by Congressman Jack

Kemp for his accomplishments (Educators to be Honored, 1972, p. Section B). He was inducted into Buffalo State College's Athletic Hall of Fame in 1985 (Buffalo State College). In addition to Grabau's contributions to Industrial Arts at Buffalo State College, he was a member of the committee that researched and wrote the book *New York State Teachers College at Buffalo, A History, 1871-1946*, referenced several times in this study.

Perhaps the best known early graduate of the Buffalo Normal School Vocational Industrial program was Dr. Gordon Owen Wilber (1897 - 1972). Dr. Wilber was born May 28, 1897 and graduated from the Great Valley High School, New York in 1917. In 1922 he earned a General Industrial diploma from the Buffalo Normal School. He went on to complete a Bachelor's degree from New York University in 1930. Wilber continued his education and completed his graduate work in 1936, and doctorate in 1941 from Ohio State University. In his early career as an Industrial Arts teacher in public schools, Dr. Wilber taught throughout New York State, including those schools in the towns of Islip, Chazy, and Little Falls. In 1933, following his experience as public school teacher, Dr. Wilber was employed as an instructor of metals at what is now the State University of New York College at Oswego. Dr. Wilber held this position until he was appointed Director of the Division of Industrial Arts in 1940 (Rogers, 1961, p. 184).

A prolific author and researcher, it was Dr. Wilber who provided the most scholarly research to date on the contribution of Jamestown's Samuel G. Love to the field of Manual Training. Dr. Wilber's most valuable work related to the field of Industrial Arts was his book *Industrial Arts in General Education*. The first edition was published about 1948; three later editions were published in 1954, 1967, and 1973. The third and

fourth editions were co-authored by Norman C. Pendered, a Professor of Technology at Pennsylvania State University and East Carolina University. Dr. William Everett Warner (1897 - 1971), professor at Ohio State University and creator of the American Industrial Arts Association (now the International Technology Education Association) and Epsilon Pi Tau, edited the first two editions. Throughout the four editions of *Industrial Arts in General Education* many of the same themes were present, yet it can also be observed that technological advances had a material impact on the evolution of Industrial Arts. The fourth edition had many new chapters including how to integrate movie and sound equipment into the Industrial Arts lesson plan as well as devices like overhead projectors and digital electronics. Dr. Wilber retired from Oswego in 1957. In addition to his academic accomplishments, he was particularly involved with Epsilon Pi Tau. Oswego had initially attempted to establish a chapter in 1931, but its petition was rejected because its Industrial Arts program did not have a degree-granting status until 1939 (Tryon, 1958, p. 9). Soon after Oswego obtained its degree-granting status, Dr. Wilber established the Epsilon Pi Tau Oswego (Phi) chapter in 1940. For many years Dr. Wilber served as the national chairman of its Board of Directors (Rogers, 1961, p. 231). In honor of Dr. Gordon Owen Wilber's outstanding service and leadership at Oswego College as well as at the national level, a building on Oswego's campus is named Wilber Hall (Mitchell, 2005, p. 11).

*2.2.2.2.9 A new Buffalo Normal School building enhances its Vocational Industrial Program.* In addition to the visible contributions of the graduates of the Buffalo Normal School's Vocational Industrial program in the community, the growth of the program was aided by the construction of a new building at the same time the



program was being formed. Because of the creation of the Household Arts and Vocational Industrial departments, the construction of a new Buffalo Normal School building was a necessity and Upton began advocating for it soon after he became principal.

Mr. Edward H. Butler had been trying in vain to obtain support to construct a new normal school building since his election as president of the Buffalo State Normal School local board of trustees in November 1902. However, with Dr. Upton as the school's new principal and with the addition of the new Vocational Industrial and Household Arts departments, things changed abruptly in Mr. Butler's favor.

Thomas E. Finegan, assistant New York State commissioner of education, said the new drive for a modern Buffalo State Normal School building was driven by the start of Buffalo State's "pedagogical department in manual training. One of the greatest needs in the country today is a force of teachers capable of manual training work. The Buffalo school, being in the center of a large population, as no other normal school in the state is, is particularly adapted for a manual-training teachers' department" (New Normal School Here, 1910, p. 6).

In any event, construction plans moved forward. On February 3, 1910, Mr. Butler was able to obtain the support of New York State Senator Henry W. Hill who introduced a bill authorizing the drawing of plans for a new Buffalo normal school, with costs not to exceed \$400,000. The bill passed the legislature and was signed by Governor Hughes on June 21, 1910.

Initial plans were drawn by the New York State architect Franklin B. Ware, and the overall design for the new school was inspired by Philadelphia's Independence Hall,

with its large central tower. However, the new school was not to be an exact replica as it had unique requirements. The specifications for the new school required it to be constructed without interference to the old structures. To meet the requirement, the new structure was planned with wings at the east and west side of the school lot, flanking the existing science building, yet far enough separated so the new wings would not obscure light from entering the science building. The school's new main façade was to the north of the science building and a third wing extended further to the north, in back of the main façade (Finegan, 1917, pp. 217-218).

While there was commitment to construct the new normal school, funding was delayed for nearly two years. The New York State Assembly noted "preliminary plans and exterior designs were prepared to the satisfaction of the local Board and the Commissioner of Education, but the Legislature of 1911 not having made appropriations for carrying on the work, these plans were filed for future use" (State of New York, 1912, p. 18). On March 6, 1912 Governor Dix signed a bill introduced by Assemblyman E. D. Jackson with an appropriation of \$100,000 so construction could begin. March 7 was a day of great celebration at Buffalo State and Dr. Upton was presented with applause for his efforts as well as a bunch of carnations tied with a red ribbon, the school color of Cornell (Senior Class of the Buffalo Normal School, 1922, p. 21). Every faculty member gave a brief speech and the celebration ended with the entire student body singing *America* (Normal Celebrates, 1912, p. 7).

The new school project was unusual because during the time the building was planned and constructed, the New York State Architect's office was held by four individuals: Franklin B. Ware, (the principal designer, who held the office 1907- April

1912); Herman W. Hoefer (April 1912-February 1913); J. Stewart Barney (March 1913); and Lewis Frederick Pilcher (1913-1923). Ware's initial architectural plans were updated and completed in July 1912 by Hoefer and put out to bid. Eight construction companies submitted sealed bids and they were opened on August 20, 1912.

The lowest bid was submitted by the Southern Dutchess Construction Company of Fishkill Landing, with a bid of \$356,661. The State architect recommended the contract be awarded to Southern Dutchess. However, the awarding of the contract was protested by the next lowest bidder, the Eastern Concrete Steel Company of Buffalo because Southern Dutchess did not submit a check with its bid and did not specify the time within which it would construct the building, both required components of the bid submittal. A hearing on the matter was held on September 16, 1912 by Andrew S. Draper, Commissioner of Education, who noted Southern Dutchess had no experience in the construction of public or other large buildings whereas Eastern Concrete had significant experience in the construction of such buildings. Therefore, based on Commissioner Draper's recommendation, the contract was awarded on October 23, 1912 to Eastern Concrete Steel Company in the amount of \$363,398 and excavation work began soon thereafter (New York State Education Department, 1913, pp. 89-92).

On April 7, 1913 Governor Sulzer signed a bill introduced by Assemblyman Jackson and Senator John H. Malone and appropriated an additional \$300,000 for the construction project, the balance needed to complete the school. The new building's cornerstone was laid by Mr. Edward H. Butler during an elaborate ceremony held on October 9, 1913. The new school was occupied at the opening of the school year in September 1914 when the building was structurally complete but not yet fully equipped.

Mr. Butler died on March 9, 1914 before the completion of the new school, but he was memorialized with an endowment from his estate to be used for the creation of the Edward H. Butler library in the new Normal school building. The current and fourth generation library facility continues to bear his name on Buffalo State's current Elmwood Avenue campus.

Immediately after moving into the new normal school, the original (constructed during 1868-1870), and its 1888 science building were razed. In 1913, the old school was described as being designed in the "Italian style with Mansard roof," in contrast to the post-Victorian "days of rigid utilitarianism; it speaks of the more romantic past, which is one of the reasons why its days are numbered" (Johnson, 1913, p. 17). When the school was being razed, it was discovered that structural support beams had fractured because of overload of use and weight.

Because of the new building, improvements to Buffalo State's Vocational Industrial program were evident when it was noted its students would be "surrounded with the most modern equipment possible." Mr. Givens and some of the Vocational program students made the list of equipment purchased for the new school (Senior Class of the Buffalo Normal School, 1914, p. 43). In the new school, the vocational teacher training shops were located on the ground floor (State Normal and Training School, 1925, p. 19). In the autumn of 1914, the shops were not yet complete, but they were expected to be "one of the best equipped shops in the country." In the building's design, there were five shop laboratories and an office for the department head. In the west wing along Normal Avenue, in classroom 5 was a bench room containing eighteen work benches, a grindstone, a bench jointer, a hollow chisel mortise, a 36-inch band saw and a

lathe. Across the hall in classroom 4 was a mill room where rough work was done with the aid of a universal saw. The three additional rooms were classroom 20, the finishing room; classroom 23 metalwork working machines and benches, and classroom 21, used to house tools for other recognized trades used for the program's expansion (Grabau, Vocational News, 1914, p. 26). It is worthy to note that the two school buildings Dr. Upton had worked to construct (the Buffalo Technical High School and the new Buffalo Normal School) were both opened during the 1914-1915 academic year.

The completion of the new normal school building was significant because it catapulted Buffalo's position among the normal schools in New York State and positioned Buffalo for the momentous growth it was to experience over the next fifteen years. At the end of the school year, 1914, of the ten normal schools in New York State operating at the time (Brockport, Buffalo, Cortland, Fredonia, Geneseo, New Paltz, Oneonta, Oswego, Plattsburg, and Potsdam), Buffalo had the lowest combined value of lot/building, furniture and library/apparatus, being valued at \$174,800 (New York State Education Department, 1916, p. 945). With the completion of the new school building just a year later, Buffalo had the most valuable normal school plant in New York State with an estimated value of \$530,652 (New York State Education Department, 1918, p. 710).

It must have been a highlight for Dr. Upton when the Eastern Art and Manual Training Teachers Association held its annual conference during April 28 - May 1, 1915. The previous time it was held in Buffalo was June 1901 when Dr. Upton was elected president. Its president in 1915 was Harry W. Jacobs of Buffalo. Dr. Upton hosted an exhibit of the Vocational Industrial program for the Association on Friday evening April

30 and Saturday morning, May 1 in the newly completed Buffalo Normal School, showcasing Buffalo State's Vocational Industrial program for a national audience. Earlier in the day, Association attendees were taken on a tour of the Larkin Factories, Bethlehem Steel, Carborundum, the Roycrofters in East Aurora, the Albright Art Gallery and the new Technical High School (The Eastern Art and Manual Training Teachers' Convention, 1915, p. 236). Fifteen years earlier, Elbert Hubbard addressed the group and personally gave them a tour of Roycroft. As fate would have it, on the closing day of the Association meeting, May 1, 1915, Mr. Hubbard was in New York boarding the *Lusitania*, sunk by the Germans on May 7. Also of note during the Buffalo meeting, it was decided the Association would change its name to the Eastern Arts Association.

*2.2.2.2.10 The Vocational Industrial Program continued growth through World War I.* 1915-1916 was also an important year at the Buffalo State Normal School Vocational Industrial department because it was that year summer extension courses were added in the machine and printing shops. Previously, classes were only open for those training to become teachers. The extension classes offered the opportunity to those in commercial shops to broaden their knowledge of their trade. Because the equipment was new, the courses were especially valuable (Vocational, 1915, p. 33). In the 1916-1917 school year, required extension class reading included the recently published book by John Dewey, *Schools of Tomorrow* (State Normal and Training School, 1917, p. 20).

The Buffalo State Vocational Industrial program continued to gain sure footing and through Dr. Upton, engaged notable men from Buffalo's vast manufacturing base. During the 1915-1916 school year, notable guest lectures included Dr. Upton on forestry, Dr. Waterhouse, metallurgist for the Lackawanna Steel Company lectured twice on iron

and steel, and Mr. Louis Bown, general manager of Buffalo Pottery lectured on commercial pottery production (Vocational, 1916, p. 58).

Buffalo State's fledgling Vocational Industrial program was impacted by the United States entry into World War I when it declared war on Germany on April 6, 1917 and the subsequent Selective Service Act of May 1917 that conscripted men between twenty-one and thirty years of age. Some of Buffalo State's Vocational Industrial program students who were drafted were sent into Army engineering departments. One such student, Alexander M. Bellony was assigned to the general engineer depot, and was responsible for improving railroads, roads, bridges and other technology such as portable hospitals and improved manufacturing processes (The Record, 1917, p. 14).

**2.2.2.3 Impact of Smith-Hughes Act on Buffalo State College Vocational Industrial Department.** The seeds of the Buffalo Normal School Vocational Industrial program were planted by Upton and began to grow quickly during World War I. This was due to national legislative changes, in part lobbied by Upton through his efforts in the National Society for the Promotion of Industrial Education. Sadly, the program's greatest growth was realized after Upton's untimely death.

**2.2.2.3.1 Death of Dr. Daniel Sherman Upton.** Upton died on Saturday, July 27, 1918 in his home, the principal's manse at 110 Fourteenth Street. Upton was at home with friends that Saturday evening and suffered a debilitating headache. He lost consciousness and his friends contacted a physician. By the time the physician had arrived, Upton had passed away. Upton's funeral was held in the home on Tuesday, July 30, 1918. It was presided over by Upton's friend, Dr. William H. Boocock, Minister-in-Charge of the First Presbyterian Church, who wrote a touching eulogy. Upton became a

member of the First Presbyterian Church on January 8, 1899; his wife, Sarah C. Chatham Upton, joined earlier on October 5, 1898 (McCausland, 2011).

In his eulogy, Dr. Boocock said Upton was a “man of quiet taste, who sought not public praise and who did his work without undue public notice,” and he was “animated and actuated in all he did by a passion for human service.” Boocock continued:

Because of his ability and energy, his power to get big things done, he was justly admired by many, but his heart power, his thoughtfulness for others, the personal sacrifices he so often made to help them, his joy in others’ advancement and good fortune, caused him to be loved best by those who knew him best (Boocock, 1918).

A memorial service was held at the Buffalo State Normal School on August 2, 1918. Miss Jane Keeler, a teacher at the Buffalo Normal School and founder of the Studio Arena Theater School, read Dr. Boocock’s eulogy of Dr. Upton (Buffalo State Normal School, 1918).

In addition to the accomplishments already noted in this study, Dr. Upton’s contributions to Buffalo State included the creation of summer school sessions, in which he organized classes for teachers to Americanize immigrants, and Saturday extension classes beginning in 1917 for the benefit of rural and other practicing teachers that enabled them to continue their education in Buffalo (Smith, Normal School of 1870s Grows into Buffalo State, 1961, p. 22D).

In 1917 Upton was in charge of a federal program implemented in Western New York to assist farmers by having high-school boys work on farms during the summer. The always patriotic Dr. Upton was active in the World War I Liberty Loan and War Saving Stamps campaigns. It was also when Upton was principal of Buffalo State that its School of Practice was expanded to include classes at School No. 38 at 350 Vermont



Street. During the time Upton served as Normal School principal, two publications were inaugurated: its yearbook, the *Elms* in 1912 (discontinued in 2007) and its student newspaper, the *Record*, in 1913. Upton was an advocate for documenting student accomplishments; when he was principal of the Buffalo Technical High School, its newsletter, the *Techtonian*, was also initiated.

Dr. Upton's death was a great loss to Buffalo. He was regarded as being "brilliantly successful" in all his work since he moved to Buffalo (Principal Upton Elected Head of Normal School, 1909, p. 1). At his death, he was praised for being a "hard worker, good thinker, born organizer, resourceful and courteous." Dr. Harry W. Rockwell, Upton's successor at the Buffalo Normal School after his death, said that Upton had vision, great capacity for friendship, service, and patriotism ("Father" of Technical High Eulogized; Tablet to Dr. Daniel Upton Unveiled, 1926, p. 14).. Upton was also referred to as a man of strong personality and executive ability (Daniel J. Upton, Principal of Normal?, 1909, p. 6).

Perhaps the most touching tribute to Dr. Upton came from a former student, Paul P. Hohorst, who was drafted into the Army and served in France during World War I. In a letter to the Buffalo Normal School students, he wrote: "My Dear Friends: A few days ago I learned of the death of our beloved Doctor Upton. All the martyrs for democracy do not die on the battlefield. Our hero worked until his physical strength could no longer stand the pace and then as Lincoln said: 'Gave the full measure of devotion'" (The Record, 1918, p. 44).

Dr. Upton was survived by his siblings (two brothers, including West Point graduate Brigadier General LaRoy Sunderland Upton and five sisters). At the time of

Upton's death, his younger brother, LaRoy, was in the midst of battle at Vaux, France. The valor he demonstrated in Vaux to hold the village against the Germans with little chance of success distinguished him as a World War I hero who was awarded the Distinguished Service Cross in Soissons, France (General Upton Here Over Night, 1919, p. 8).

Daniel Upton was also survived by his wife, Sarah, an Elmira schoolteacher who he met during the time he worked at the Reformatory. They married in Elmira on December 18, 1894 (Upton-Chatham, 1894). The Uptons had no children. Dr. Upton is buried with his wife and sister-in-law, Helen G. Englebreck (a history teacher who joined the Buffalo State faculty in 1911), in Buffalo's Forest Lawn Cemetery, Section 14, Lot 602.

Upton had a family steeped not only in military history, but also mechanical history. In the 1860s, Upton's two uncles, James Stephen and Parley, invented and manufactured a threshing machine called the "Michigan Sweepstakes" and later founded the Upton Manufacturing Company (Gardner, 1913, p. 356). In 1911, Upton's first cousins once-removed, Louis Upton (1886–1954) and Frederick Upton (1890–1986), were co-founders of the Upton Machine Company in St. Joseph, Michigan (later the company became known as the Whirlpool Corporation). The firm's first products were wringer washing machines powered by primitive electric motors (Phythian, 2008).

While Dr. Upton died in 1918, his memory and contributions to Buffalo's technical education continued to be felt. Just a year after Upton's death on August 6, 1919, the Batavia Soldiers and Sailors' Civil War monument was dedicated outside of the Genesee County Courthouse and featured a bronze statue of Upton's uncle, Emory Upton

(Starowitz, 2011). The dedication was attended by Daniel Upton's brother General LaRoy S. Upton, who was a featured speaker at the event (Monument Dedication Impressive, 1919, p. 8).

A memorial bronze tablet, made by Joseph Balk, a former Technical High School student who studied under Dr. Upton, was dedicated on September 29, 1926. The tablet reads: "1864-1918, Dr. Daniel Upton, Scholar Educator Leader, Founder and First Principal, of the Buffalo Technical H.S., 1904-1908, The Spirit of His Work Eternal Stands, Erected in Loving Memory by His Friends and Pupils" ("Father" of Technical High Eulogized; Tablet to Dr. Daniel Upton Unveiled, 1926, p. 14). Among those at the dedication were Louis Bleich, an alumnus from the Buffalo Technical High School initial graduating class (1907), Cyril Gordon Ryther, Valedictorian of the second graduating class of the Technical High School, and Andrew W. Grabau, 1915 class president of the Buffalo Normal School (Old Tech Students Pay Honor to Upton Memory; Unveil Memorial Tablet, 1926, p. 19). The tablet, mounted on a pillar in the lobby, remains in the school as of February 2011 (Napora, 2011). In 1926, the Tri Sigma-Daniel Upton Memorial Scholarship Fund, the first endowed scholarship at Buffalo State, was established by the Zeta Chapter of Sigma Sigma Sigma sorority to perpetuate the memory of Dr. Daniel Upton. The scholarship was intended to be given to a deserving student whose scholarship, character and school spirit excel. The fund was maintained by Liberty bonds purchased by Buffalo State students during World War I, encouraged by Upton (Unveil Tablet to Memory of Daniel Upton, 1926, p. 5). In 1931, four bells were dedicated at Rockwell Hall clock tower to sound the Westminster peal for Buffalo State's college students. The largest bell, which sounds the major scale G note, was transferred

from the Jersey Street Normal School building. An anonymous donor purchased the D bell as a memorial to the three former principals of the school (Wofford, 1946, pp. 72-73). It bears the inscription:

In loving memory of the three former principals  
whose labors have contributed to the development of this institution  
Henry B. Buckham, 1871-1886  
James M. Cassety, 1886-1909  
Daniel Sherman Upton, 1909-1918  
To live in hearts we leave behind is not to die.

In 1940, the Buffalo State Teachers College organized the Daniel Upton Chapter of the Future Teachers of America (now Future Educators Association) (Wofford, 1946, pp. 139-140). Finally, Dr. Upton's memory was revived yet again at the dedication of Upton Hall, more than 40 years after his death.

*2.2.2.3.2 Creation of the Smith-Hughes Act.* The expansion of Buffalo State College's Vocational Industrial Department was greatly aided by the Smith-Hughes National Vocational Education Act of 1917, created by the United States Congress and signed into law on February 23, 1917 (public law 64-347). The passage of the Smith-Hughes Act signaled the beginning of the federal role in vocational training and was the nation's first law that authorized federal government oversight of a portion of high school curricula (Wolfe, 1978, p. 8). The Act promoted vocational agriculture and provided federal funds to provide training in modern farming methods, the trades and home-making. The Smith-Hughes Act put into law the recommendations of a commission appointed by President Woodrow Wilson and documented in Charles Allen Prosser's 1914 *Report of the National Commission on Aid to Vocational Education*. The commission found few of the 12 million Americans engaged in agriculture or the 14 million engaged in manufacturing had any training for their labor. The Smith-Hughes

Act authorized up to \$7.5 million annually to be spent on vocational programs in agricultural, manufacturing, and home economics education, as well as teacher training in each area (Urban, 2010, p. 22). With its initial budget of \$1.86 million, it became the basis for the promotion of vocational education and for its independence from the rest of the curriculum in most school settings, where it had been formerly integrated (U.S. Department of Education, 2010, History section, para. 2).

The Smith-Hughes Act funding was limited to salaries of teachers in agriculture, trades, industrial subjects, and home economics as well as the training of teachers of agriculture, home economics, and vocational subjects (Norman, 1922, p. 86). The Smith-Hughes remained intact until 1936 when the George-Deen Act doubled the appropriation from \$7 to \$14 million and made the appropriation perpetual instead of subject to renewal (Urban, 2010, p. 22).

*2.2.2.3.3 Impact of Smith-Hughes Act on Buffalo Normal School's Vocational Industrial Program.* The Smith-Hughes Act had an immediate impact on the Buffalo Normal School's Vocational Industrial Program. The students of the program recognized their new-found importance. Within New York State, the Albany State College for Teachers, Cornell University and the State Normal School at Buffalo were designated at the teacher training centers to receive the Smith-Hughes federal funds (Senior Class of the Buffalo Normal School, 1922, p. 25). Julius D. Layer, a graduate of the 1917 Buffalo Normal School Vocational class, remarked "The Federal Government by its recent appropriations and provisions for vocational education, sincerely encourages us, and expresses its utmost faith in and its approval of our aspirations" (Senior Class of the Buffalo Normal School, 1917, p. 65).

Buffalo State said through the Smith-Hughes Act, the national government placed itself clearly on record as “favoring the introduction of industrial training into the school system of every state. The present period [1918], and the period after the war, will witness a significant development in the field of trade education.” The school was actively seeking teachers from “qualified men and women drawn from the trades and from the industrial occupations” (Buffalo Normal School, 1918).

As a direct impact of the Smith-Hughes Act, during the 1917-1918 school year the Vocational Industrial evening course was shortened from three to two years, offering a certificate to graduates in lieu of a normal school diploma (Tutthill, Vocational Junior Class, 1918). Until 1922, New York State’s normal diploma was based on two years of full-time study (Senior Class of the State Teachers College at Buffalo, 1927, p. 35).

The 1918-1919 school year was a very significant one for Buffalo State and marked the change of a new direction in the Vocational Industrial program. Beginning that year, the Vocational Industrial program was supported by the federal government through the federal board for vocational education and New York State through the State Education Department and the Buffalo Normal School. One half of the cost of the program was provided by the federal government. During that year, the allocation for New York State was \$69,614 and split among four designated schools: Buffalo and Oswego State Normal Schools, Albany State College for Teachers, and the State College of Agriculture at Cornell University. At Buffalo State, the program was filled to capacity with 81 students enrolled (Teachers' Quota for Vocational Study Reached, 1918, p. 4). The 1919 Vocational Industrial graduating class included both the final graduates of the

three year course and graduates of the newly-revised two year course (Senior Class of the Buffalo Normal School, 1919).

*2.2.2.3.4 Buffalo Normal School's Vocational Industrial Program faculty changes.* In the midst of Buffalo State Vocational Industrial program's rapid growth, the department witnessed significant faculty change during its first decade in addition to the loss of Dr. Upton. In September 1914 Joseph T. Phillippi, a graduate of the Fredonia State Normal School and University of Buffalo joined the staff as a vocational teacher. In September 1915, the Vocational Department's faculty was expanded with the addition of Edward H. Tingley, M.E. (Finegan, 1917, p. 222). When Tingley joined Buffalo State, it was noted he was "well equipped with both theoretical and practical knowledge of his work" (Students of Buffalo Normal School, 1915, p. 33). In addition to being a teacher, Tingley was also an author: in 1924 he co-wrote *Organization and Budgetary Control in Manufacturing* and in 1937 he wrote *The foreman -- his personality*.

Before the start of the 1915-1916 school year, Givens resigned from Buffalo State to become director of Industrial Training at the Kansas State Teachers College, formerly known as the Auxiliary Manual Training Normal School of Pittsburg, Kansas (NEA Bulletin, 1916). Now known as Pittsburg State University, it has been a national center of Industrial Arts and Technology Education. Like Tingley, Givens authored at least two books: *Blue-print Reading and Shop Sketching for the Metal Trades* (1924) and *Reading House Plans, Blue Print Reading for the Building Trades* (1928).

In 1917, Robert Carlton Woellner joined the Buffalo Normal School Vocational Industrial Department faculty, a graduate of Bradley Polytechnic Institute, the University of Cincinnati, and Columbia University. After Givens left Buffalo State, during 1916-

1918 the primary Vocational Industrial teacher was Mr. Tingley and in 1918 it was Mr. Woellner.

Despite the presence of Tingley and Woellner, with Dr. Upton's death in the summer of 1918, the Vocational Industrial program lost a capable leader. A man of great renown, Mr. Oakley Furney (1886 – 1965), answered the call to fill Upton's shoes at a particularly challenging time because of the program's transformation under the Smith-Hughes Act. Furney, a graduate of Brockport Normal, also held a Bachelor of Arts degree from the University of Michigan and a Master of Pedagogy from Albany Teacher's College in addition to further studies at Columbia University, Rochester Mechanics' Institute, and Stout Institute. Before coming to Buffalo, Furney served for six years as director of vocational education in Albany's school system (Teachers' Quota for Vocational Study Reached, 1918). Upon coming to Buffalo, Furney was placed in charge of Buffalo State's Vocational Industrial program in addition to his responsibilities as agent for the Division of Agricultural and Industrial Education of the New York State Education Department (The Record, 1918, p. 44). Furney was only at Buffalo State for a short time as he was transferred to the State Department of Education in Albany in 1919 (Wofford, 1946, p. 62). Although removed from Buffalo, Furney remained in an influential position in Albany where he became chief of the State Bureau of Industrial and Technical Education and assistant state commissioner for vocational education (Oakley Furney Dies In Albany, 1965, p. 3).

In 1920 Furney was replaced at Buffalo State by Mr. Irving C. Perkins (1890 – 1962). Perkins brought a great deal of education and diverse experience to Buffalo State as well as guiding the program through its period of greatest growth and his career



marked by an extraordinarily long tenure. Born in London, Perkins moved to the United States with his family at the age of five. He grew up in Maine and studied engineering at the University of New Hampshire at Durham where he graduated in 1912. He had engaged in post-graduate work at Columbia University and received a Master of Arts in Vocational education from the University of Buffalo in 1932 (State University College at Buffalo, 1962). After his graduation from New Hampshire, Perkins worked as an assistant to the famous American eugenicist and biologist, Charles B. Davenport in his eugenics laboratory. Perkins subsequently worked at the Leatherold Manufacturing Company in Kennebunkport, where he developed an understanding of the problems of industry and production that proved valuable to him as an instructor.

During 1913-1917 he was head of manual training for the schools of Camden, Maine and later Auburn Maine. Perkins was then appointed supervisor of industrial education for the State of Maine and was appointed Supervisor for Vocational education in the State of Rhode Island (Smith, Men You Ought to Know. Irving C. Perkins., 1931, p. 8.9).

*2.2.2.3.5 New York State Industrial Department moves from Albany to Buffalo Normal School.* Buffalo State's Vocational Industrial program was bolstered in 1919, when Mr. Lewis A. Wilson, Director of Industrial and Agricultural Education for the State of New York, introduced a bill to the state Legislature to move the Industrial Department of the New York State College for Teachers at Albany to Buffalo. The move was advocated because Buffalo was, at the time, one of the state's largest industrial cities and because of the presence of Buffalo's technical and vocational high schools as well as its eight junior high schools (Industrial Department May Go To Buffalo, 1919, pp. 1,3).

The move was approved by the Legislature and the program in Albany was discontinued (French, 1944, p. 160). During the summer of 1920 \$60,000 of mechanical equipment was relocated from Albany to Buffalo and four additional faculty members moved to Buffalo. The newly enhanced, reorganized Vocational program, with an emphasis on Industrial subjects, was active at Buffalo State by September 1920 (Wofford, 1946, p. 62). Additional funds of \$18,000 were allocated to complete the new shops at the Normal School (Senior Class of the Buffalo Normal School, 1922, p. 29).

With the movement of the Vocational Industrial program from Albany to Buffalo, the program had several distinct divisions or aspects. For the first time in several years, day programs returned. Initially, the newly revised program began as a two-year full time day general industrial course to train teachers in manual training, vocational courses, and industrial arts classes.

A new, special one-year day course was offered to those who had trade experience of not less than five years and were considered masters of their trade or profession. Early in 1920 the New York State legislature appropriated a budget for twenty-five annual state-wide scholarships offered to students of the Buffalo Normal one-year program; between 200-300 students applied. The scholarship offered \$1,500 to each student with no dependents and \$2,000 for students with dependents, a “substantial sum in recognition of his financial sacrifice in leaving industry for the laudable objective of becoming an exponent of vocational education” (Senior Class of the Buffalo Normal School, 1921, p. 49). The scholarships were awarded to qualified persons with at least five years’ experience in a limited amount of industrial and technical occupations: automobile repairing; machine shop work; electrical construction (repairing and

operating); machine drafting and designing; textile working (weaving spinning, knitting and dyeing); sheet metal working; industrial chemistry; baking; bricklaying; shoemaking; printing (composition, press work and book binding); carpentry; wood pattern making; painting and decorating; textile designing; architectural drafting and design; and tailoring and garment design. Salaries for teachers of these trades averaged between \$1,800 and \$3,500 annually (Winship, 1920, pp. 248-250). The scholarship stipend program continued throughout the 1920s, although the amount of the scholarship was reduced to \$1,000 annually, paid in installments of \$100 for ten months (Qualified Trade Teachers, 1922). By 1925, thirty-five scholarships were awarded and the scope of the scholarship specifically included the following approved trades for women: dressmaking; millinery; power machine operation; novelty workers; and paper box makers (State Scholarships for Trade Teachers, 1925, p. 14). For example, in the 1926-1927 school year, Rose Cohen, a garment designer from New York City, won the scholarship and studied for a year at Buffalo State (Senior Class of the State Teachers College at Buffalo, 1927, p. 38). In 1927, twenty-five vocational \$1,000 scholarships were offered and three were awarded to women (25 Scholarships Awarded, 1927, p. 27).

At graduation, a certificate was provided to each graduate of both the one-year and two-year program, although they were slightly different. A graduate of the two year program was certified to teach general industrial or technical subjects while the graduate of the one-year program was certified to teach a specific trade, industrial or technical subject (State Teachers College at Buffalo, 1928, pp. 51-52).

An evening school provision was made for students to attend evening classes so they could earn a temporary vocational teacher's certificate and graduates of those classes

had the opportunity to earn a permanent vocational certificate by completing 240 hours of work in extension courses or by attending summer school courses (State Teachers College at Buffalo, 1928, p. 50). In addition to the one-year day program, the two-year day program, and the evening program, a special program for returning World War I veterans was also created; about 70 veterans were enrolled in that program (Senior Class of the Buffalo Normal School, 1922, p. 29).

The national significance and support by the federal government of the Buffalo Normal School's Vocational Industrial program can be witnessed not only by these programs, but also through its publications. Because of the Smith-Hughes Act, many states attempted to create Vocational Industrial programs to tap into the federal funding allocation. The evening program developed at Buffalo Normal School in 1910 was designated a short-unit discontinuous intensive training course. The federal government noted "Training of this type has for some time been conducted in the states of Massachusetts and New York, and has since been developed in a number of states." The Buffalo Normal School was one of four programs nationally identified as a model. The Federal Board for Vocational Education said "During the period of their development, courses of this character were conducted by . . . the Buffalo Normal School under the direction of Mr. H.C. Givens" (Allen C. R., June 1921, p. 15).

*2.2.2.3.6 Buffalo State Vocational Industrial program changes during 1920s and 1930s.* Overall, the New York State Vocational Industrial curriculum remained unchanged from its creation in 1911 until January 1, 1921 when a revised two-year fulltime day curriculum was established that refocused the curriculum on Industrial Arts (Rogers, 1961, p. 98). In addition to the two-year Industrial Arts program, Buffalo

Normal continued its one-year scholarship program for twenty-five vocational teachers who already had mastery of a particular trade (State Normal and Training School, 1926, p. 50).

The New York State Vocational Industrial program received its first major overall with the institution of a three-year full-time program in the spring of 1929 (Rogers, 1961, p. 147). Two programs were offered at Buffalo State in 1929: a three-year Industrial Arts teacher-training curriculum in addition to the one-year day Industrial Teacher-training curriculum (State Teachers College at Buffalo, 1929, p. 59). Planning also began in 1929 for a four-year industrial course (Senior Class of the State Teachers College at Buffalo, 1931, p. 18).

1931 was an important year for the Buffalo State Industrial Arts program for it was that year the college submitted four-year curricula to the State Department of Education for its Industrial Arts Teacher Training and Vocational Industrial Teacher Training programs. Each course required 124 credit hours and graduates were awarded a Bachelor of Science degree in education (State Teachers College at Buffalo, 1931, pp. 75-81). That same year, for the first time in the program's history, it moved into its dedicated building, the Vocational Building, on the new Elmwood Avenue campus. With its own building, the program had a planned expansion with auto mechanic and general shops (Senior Class of the State Teachers College at Buffalo, 1931, p. 18).

In the early 1930s, the program continued to offer its one-year day industrial teacher training curriculum for tradesmen and women with five years' experience and its three-year industrial arts teacher training curriculum. Students who remained for a fourth year could take classes to complete the requirements for a degree in Industrial Arts

Education or Vocational Industrial Education (State Teachers College at Buffalo, 1933, pp. 81-89). By 1935, only the one-year and four-year programs were offered (State Teachers College at Buffalo, 1935, pp. 75-86).

***2.2.2.4 Significant Growth of Buffalo State College and its impact on its Vocational Industrial Department.*** During the forty year period between approximately 1925 and 1965, Buffalo State College experienced unprecedented change and growth. During the 1920s, the Buffalo Normal School became a college dedicated to training teachers and its maturity and rapid growth necessitated it move from its one-block campus on Jersey Street (between Normal Avenue and Fourteenth Street) to its present Elmwood Avenue campus in January 1931.

***2.2.2.4.1 Baccalaureate degree approval for Buffalo Normal School.*** The Smith-Hughes Act, in addition to bolstering the Vocational Industrial Department, was also responsible for another milestone at the Buffalo Normal School: the ability to grant Bachelor of Science degrees. In September 1919, New York State Board of Regents authorized the Buffalo Normal School to award a Bachelor of Science degree in Home Economics, equivalent to the degree given in any college of liberal arts and sciences in New York State. The Buffalo Normal School's Homemaking department (formerly known as Household Arts) was initiated by Dr. Upton in September 1910, and its first director was Elizabeth C. Lange. During the time the program was approved by New York State to grant a Bachelor of Science degree, it was led by Myrtle Viola Caudell (1878 – 1963). She was the program's director from February 1919 until 1938 and the namesake of Caudell Hall. A photograph of Caudell is shown in Figure 22.



**Figure 22. Myrtle Viola Caudell, who led the Buffalo Normal School's Vocational Homemaking Department and received the State's authorization in 1919 to grant the Normal School's first Bachelor of Science degrees in Home Economics. Courtesy of Ben Morgan.**

The Home Economics program was lengthened from three to four years and in June 1921 twelve women graduates of the program became the first to receive a Bachelor of Science degree from the Buffalo Normal School (Senior Class of the Buffalo Normal School, 1922, p. 27). This significant accomplishment was the fulfillment of a vision created 55 years before when in 1866 Buffalo Public Schools Superintendent John S. Fosdick sent a letter to the Buffalo Common Council describing the proposed Buffalo State school. Fosdick said in addition to the normal school, Buffalo State would include a college, established “so that there will be no necessity of sending young men from our city to be educated” (City of Buffalo, 1867, pp. 271-272). The planned college was “not

designed to exclude those who do not pledge themselves to be teachers but admitting all who are properly qualified . . .” (Greene W. H., 1871, p. 11). While the vision was fulfilled, Superintendent Fosdick may have been surprised because Buffalo State’s initial Bachelor of Science candidates were all women. Fosdick may have expanded his view, because by 1871, William H. Greene, secretary of the school’s local board said that at Buffalo State College, “both sexes will be admitted on equal footing to its classes and its degrees” (Greene W. H., 1871, p. 11).

A second baccalaureate milestone occurred on April 28, 1925 when the New York State Board of Regents authorized the Buffalo Normal School to grant a Bachelor of Science degree in education upon completion of its four-year general education course. This momentous occasion was very significant for Buffalo. In 1890, the Albany Normal School was the first of New York State’s normal schools to offer a Bachelor of Science in Education degree. After 1900 there was resistance by powerful colleges and universities to allow any of the other New York State normal schools to confer degrees. They feared “extending the privilege to the lowly normals would cheapen degrees” (Rogers, 1961, p. 185).

Nevertheless, the State Board of Regents recognized Buffalo State’s fourth year educational curriculum on June 24, 1926 and gave permission for the institution to confer degrees in June 1927 (Senior Class of the State Teachers College at Buffalo, 1927, p. 35). Therefore, it was possible to grant a four-year degree to those who completed the Vocational Industrial program at Buffalo while none of the other normal schools in New York State had this privilege until 1939 when the Board of Regents authorized Oswego to confer a Bachelor of Science in Industrial Arts education (Oswego State University of



New York, 1941, p. 1). While Oswego established its four-year Industrial Arts program in 1932, its first Bachelor of Science education degrees were conferred in June, 1940; its first general elementary degrees were conferred two years later, in 1942 (Rogers, 1961, p. 187).

*2.2.2.4.2 Buffalo State's initial Industrial Vocational program Baccalaureate degrees awarded.* It is ironic that while Oswego State Normal School may lay claim to one of the nation's first Manual Training programs for teachers, it was Buffalo State College that became the first of New York State's normal schools to offer a baccalaureate degree in Industrial Arts. Buffalo State College announced by the late 1920s it was "possible for graduates of the two-year industrial teacher-training program to receive full credit toward a degree in education" (State Teachers College at Buffalo, 1928, p. 50). Mr. Edward H. Butler, longtime president of the Buffalo State local board of trustees, seemed to have a goal that the vocational programs would lead the college to confer Bachelor's degrees. Although Butler died in 1914, it was noted by his biographer Helen Englebreck that his "dream of expanding the State Normal into a College with a curriculum embracing the vocational and industrial was realized only after his death" (Wofford, 1946, p. 100). While Butler did not live to see Buffalo State become a college with technology programs, he did present diplomas to its first two Vocational Industrial program's graduating classes in 1912 and 1913 (State Normal School to Hold Graduation Exercises Tonight, 1913, p. 13).

Presumably because the State Teachers College at Buffalo was the only one of New York State's normal schools that could issue a baccalaureate degree at the time, enrollment soared. In 1928, the college warned those applying to the Industrial program

“due to the increasing numbers applying for admission to the school, it is absolutely necessary that those interested present their application before August 1<sup>st</sup> and under no considerations are students admitted at midyear” (State Teachers College at Buffalo, 1928).

On May 27, 1927 the Buffalo Normal School’s name was changed to the Buffalo State Teachers College and in June that year, the institution conferred its first Bachelor of Science degrees in education. The senior class said of the event, it “brought the opportunity and means for an unlimited and boundless future” (Senior Class of the State Teachers College at Buffalo, 1927).

For the Buffalo State Teachers College Industrial program, 1928 was a landmark year. While Buffalo State’s initial B.S. in Education candidates graduated in 1927, none were from its Industrial program. The program’s first B.S. in Education/Industrial was conferred in June 1928 to Wahlter F. “Buttercup” Chavel (Senior Class of the State Teachers College at Buffalo, 1928, pp. 30, 36). Mr. Chavel’s graduation marked the fulfillment of Buffalo State’s initial vision, as the third envisioned department, in addition to the normal and collegiate departments, was the scientific department. Within the scope of the applied scientific department envisioned in 1871 were mechanical and field engineering as well as architecture (Greene W. H., 1871, p. 14). Other early B.S. Ed./Industrial graduates included George Huber in 1929 (Senior Class of the State Teachers College at Buffalo, 1929, p. 32) and Sol Gilman in 1930 (Senior Class of the State Teachers College at Buffalo New York, 1930, p. 49).

*2.2.2.4.3 Buffalo State’s Industrial Vocational program becomes Industrial Arts program.* Also adding significance to the Industrial Arts field during the late 1920s, in

1929 Epsilon Pi Tau, international honor society fraternity for Industrial Arts, was created by Dr. William Everett Warner at Ohio State. This technical fraternity was created to develop prestige within the field of Industrial Arts (Tryon, 1958, p. 4). Buffalo State College's chapter (Tau) is one of the two former New York State normal schools that has a current chapter, the other being Oswego. The Buffalo chapter was formed in 1938, and in its early years hosted annual meetings with national leaders in the field of education. It was affiliated with the Alpha Chapter and Louis J. Callan from Webster, New York (Wofford, 1946, p. 149).

Following national trends, the term "Industrial Arts" began to be used at the Buffalo Normal School. Courses named "Industrial Arts" were incorporated into the Kindergarten and Intermediate (grades four, five, and six) three-year Normal Curriculum based on the course of study approved by the State Board of Regents and effective September 1922 (NY, 1923, pp. 20-21). One unintended outcome of the Smith-Hughes Act was the focus on Vocational Education during the period of 1917-1921 as opposed to Industrial Arts. One historian of the Oswego program noted Industrial Arts' "shop programs at Oswego and Buffalo were scuttled in favor of training teachers for general industrial shopwork" (Rogers, 1961, p. 145). However, with the revisions to the program by the New York State Educational Department in 1921, a focus on Industrial Arts education resumed (Rogers, 1961, p. 146).

Buffalo State had the advantage of having Irving C. Perkins as the head of the Industrial Arts department for an extraordinary long tenure during the time of great change. Mr. Perkins was in charge of the department from 1920 until his retirement in 1953 (Buffalo State Teachers College, 1953). Perkins offered great stability at Buffalo

State during this time and was able to focus the program on Industrial Arts, even though there were two separate programs: Industrial and Vocational. In 1931, the year Buffalo State moved to its present Elmwood Avenue campus and the same year the college submitted its four-year Industrial curricula to the State of New York, Perkins said: “My students are divided into two groups, the high school graduates who are preparing to teach manual training in the elementary and secondary schools and the men with an industrial background whose intention is to become instructors in the vocational schools” (Smith, *Men You Ought to Know*. Irving C. Perkins., 1931, p. 8.9). Despite the dual nature of Buffalo State’s curricula, it appeared as though Perkins embraced developing programs that taught a general knowledge of technology. Those programs incorporated into the Kindergarten and Intermediate grades were identified as Industrial Arts and described as “a study of the industries which depend largely on art for their excellence, particularly those industries which provide food, shelter and clothing, the greatest needs of man” (State Normal and Training school, 1924, p. 39). Dr. Upton would likely have approved of this definition, for he rhetorically asked the question of Buffalonians: “What would be the effect if every artist artisan (every man is an artist if he does his work properly and with the right spirit) in Buffalo had received the added impetus of a training in the arts and sciences of his trade?” (Upton D. S., *Manual Training; Buffalo's Future*, 1903, p. 4).

While Buffalo State continued to refer to its Industrial Arts department as the “Vocational Industrial Department” until 1937-1938 (the department was sometimes referred to as the “Industrial Teacher Training Department” or “Industrial-Vocational Teacher-training Department” in various publications). During 1928-1929 the school’s

catalog was the first one that referenced “Industrial Arts” teachers (State Teachers College at Buffalo, 1928, p. 50). The 1937-1938 catalog was the first year the department was referred to as the “Industrial Arts Teacher-Training Department” (Buffalo State Teachers College, 1937-1938, p. 82). Previously, the program was called the “Vocational Industrial Teacher-Training Department,” designed to prepare “teachers for the Industrial Arts program in the junior and senior high schools” (Buffalo State Teachers College, 1936-1937, p. 80).

*2.2.2.4.4 Women in Buffalo State’s Industrial Arts program.* Despite the program’s evolutionary changes, its demographic remained constant: enrollment continued to be dominated by men, with one exception. In the first decade of Buffalo State’s Vocational Industrial program, it included dressmaking. Technically, the Vocational Industrial program’s first female graduate was Anna H. Boyd, who graduated with a normal school diploma in Vocation Industrial dressmaking in June 1916. Boyd was remembered by the rest of the Vocational class, which were all males when they included her in their senior poem: “Miss Boyd, who is admired by all, for she’s a dressmaker, don’t you see? And is just as neat as she can be” (Senior Class of the Buffalo Normal School, 1916). Because of the one-year vocational scholarship program of the 1920s for experienced trade people, there was included within that scope women who had more traditional masculine jobs, although it was fairly infrequent. For example, one of the few from this category was Paula Eisenman from New York City who studied at Buffalo State Teachers College in the 1927-1928 school year (Senior Class of the State Teachers College at Buffalo, 1928, p. 34).

However, in more traditional masculine-identified studies, a gender milestone wasn't reached until 1947, when Mary Jacobs graduated with a B.S. in Industrial Arts Education and was the program's first female B.S. graduate (Senior Class of the State Teachers College at Buffalo, 1947, p. 135). The program's second graduate was Jean Eastwood Schneider, who graduated in 1952. Eastwood was influenced in her career choice by her father who owned and operated a small machine shop in Alden. Eastwood challenged gender roles and was "convinced a woman can be as skillful with shop equipment as a man is." Eastwood was a pioneer for females in the field and was described as being a "whiz at operating lathe, band saw, circular saw and other machine tools most women don't dare touch." Lest her from being perceived as being too masculine, she was further described her as being "thoroughly feminine" and as "capable as designing and making a dress or whipping up a meal as . . . building a piece of furniture" (Smith, Applied Arts Teacher Has Opportunity, 1954, p. 30C). The only other female graduate of the program during the decade of the 1950s was Lian Sae Whitelaw Bloom, who graduated in 1959 (Senior Class of the State Teachers College at Buffalo, 1959). Like Eastwood before her, Whitelaw's presence in the program was surprising to many, as was her choice of a part-time job during college at Ben Glaser's Service Station, 1261 Hertel Avenue. She was featured in a *Buffalo Evening News* article where her choice of field of study was deemed a "masculine field." She said her transportation studies at Buffalo State which included automobile mechanics was "the most interesting of all." She decided to get a part-time job at a gasoline station to give her more practical knowledge in her studies. Her employer, Robert Appelbaum, said he hired Whitelaw as a "gag" but went on to say her performance was better than "lots of boys" he hired and

added “she wants to know everything about cars.” Her duties included pumping gas, greasing cars, adjusting brakes, changing tires, cleaning spark plugs, tinkering “intelligently” with valves and checking transmission fluid, among other duties. However, these duties challenged traditional gender roles of the era and she was sometimes accused of “taking a job away from some boy.” So as not to challenge gender roles too radically, the article concluded by Whitelaw saying if she had a flat tire while on the road, “if there’s a man around, I’d let him change it” (Buell, 1958, p. 49).

#### ***2.2.2.5 Impact of post-World War II national legislation on Buffalo State***

***College’s Vocational Industrial Department.*** Buffalo State’s Industrial Arts program was greatly impacted in 1948 when the college became part of the new State University of New York (SUNY) system (LaHood, 1972, pp. 12-13). In the early 1960s, the college grew again as it was transformed, along with all of SUNY’s teacher’s colleges, into a liberal arts/applied learning college with an emphasis on teacher education. Paralleling the College’s growth, Industrial Arts program enrollment was 302 students in 1946 and 378 students in 1961. Throughout its entire history, the decade of the 1960s was perhaps the most transformative for Buffalo State College’s Industrial Arts program. Buffalo State College’s technology programs echoed national trends influenced by significant changes in technology education during the mid-twentieth century.

Just as Buffalo State College’s programs were bolstered after World War I by the Smith-Hughes Act, they were assisted once again by changes in national educational policies. In 1946, the George-Barden Act was passed, increasing funding for vocational education. It called for the construction of regional vocational schools to train technicians skilled in math and science (U.S. Department of Education, 2010).

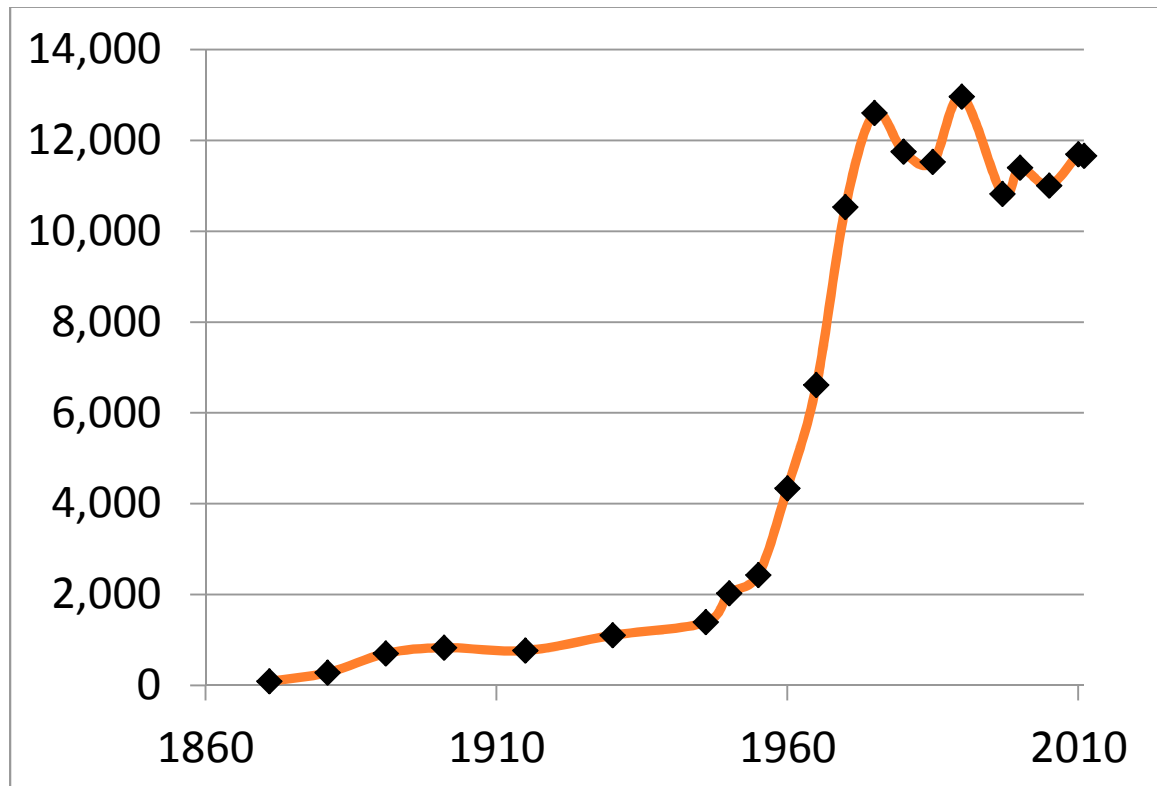
*2.2.2.5.1 Sputnik and the National Defense Education Act.* On October 4, 1957, a small spherical artificial satellite, Sputnik 1, was launched into orbit around the Earth by the United Soviet Socialist Republic (Jorden, 1957, p. 1). The event stunned the citizens of the United States and had significant impact on social, economic and educational policies during the decade that followed, pushing the United States into the “space race.” The Sputnik launch challenged the American belief that the United States was superior in math and science to all other countries (McDougall, 2010).

In response to Sputnik, the United States passed the National Defense Education Act (NDEA) on September 2, 1958. The citizens of the United States feared technology schools in the Soviet Union were superior to American schools, and Congress responded by creating NDEA to strengthen the teaching of mathematics, sciences and modern foreign languages in American schools with a total funding allocation of \$887 million.

NDEA fulfilled two purposes. First, it was designed to provide the United States with skilled defense-oriented personnel and emphasized education in mathematics, science, and engineering students, through Title II of NDEA, which provided funding for \$300 million for this purpose. Secondly, through Title II of the Act, the National Defense Student Loan program, NDEA included funding of \$295 million to provide financial assistance for thousands of students who would be part of the growing numbers enrolling at colleges and universities in the 1960s. At Buffalo State College, NDEA’s financial aspect played an important role in 1963 when the school began to charge \$400 tuition annually, although every student, no matter how high their family income, was entitled to at least \$100 each year in aid to offset the cost of tuition. Nonetheless, most students who couldn’t afford the tuition applied for a National Defense Student Loan (Buffalo



State Tuition Plan Hasn't Slowed Applications, 1963, p. 18). Overall, enrollment more than doubled at Buffalo State College during the 1960s, growing from 4,338 in 1960 to 10,532 in 1970. The growth of the college's total enrollment, including both undergraduate and graduate students, is depicted in the graph found in Figure 23.



**Figure 23. Enrollment at Buffalo State College, 1871-2011. Conversion to a multi-purpose college and the National Education Defense Act helped to drive exponential growth during the 1960s.**

Another important aspect of NDEA was the amendment and additional funding for the George-Barden Act of 1946. Title VIII of NDEA amended the George-Barden Act, providing \$60 million to stimulate technical training programs in the wake of the launching of Sputnik.

Given NDEA's emphasis on high-technology and theoretically-focused science and mathematics, Industrial Arts was not viewed as playing a vital part in preserving the American way of life. Enrollments began to wane in the 1960s (Foster P. N., Lessons from History: Industrial Arts/Technology Education as a Case, 1997, Educational trends during the 1960s and 1970s section, para. 1).

*2.2.2.5.2 Impact of the Vocational Education Act.* As enrollment in traditional Industrial Arts classes began to wane, a new transformative technology, an example of applied learning in mathematics and electronics began to impact postsecondary educational institutions: computers. Computer technology began to grow at this time, both in business and educational institutions. NDEA did provide some funding for computers, but mainframe host computers were not yet widely accepted in schools (Murdock, 2008, 1963 section, para. 1). The earliest computer in education was the Aiken/IBM Mark 1 at Harvard University in 1944 and the ENIAC in 1946 at the University of Pennsylvania (Molnar, 1997, The First Computers section, para. 1).

Other significant federal legislation events took place in the early 1960s. In 1963, the Vocational Education Act (VEA) was passed, replacing the original Smith-Hughes Act of 1917. The VEA was a major expansion and modification to vocational education. The Act's goals were to enroll a larger proportion of the baby boom generation moving through the educational system and to improve the variety and quality of training available to them. The Act also made vocational education programs more inclusive, and directed them to prepare all groups in the community for employment regardless of their vocational emphasis. It also directed funds to the retraining of adult workers who were displaced by technological change (Wolfe, 1978, p. 8). Significantly, the VEA also

provided funding for the use of computer technology in schools; however, the mainframe and minicomputers in use at the time were using batch processing methods which limited its appeal as a means of applied education (Murdock, 2008, 1963 section, para. 1). The VEA was enhanced and amended by the Vocational Education Amendments Act of 1968 that provided additional program funding, provided funds for secondary schools, and was expanded to meet the needs of the handicapped Americans (Perkins, 1968). The impact of VEA and its 1968 amendment to Buffalo State College's technology programs can be seen when it said "The expanded interest in vocational technical education throughout the nation as evidenced by the passage of the 1968 Vocational Educational Amendments Act has created an unprecedented demand for teachers in this area" (State University of New York College at Buffalo, 1969, p. 196).

*2.2.2.5.3 Daniel Sherman Upton Hall.* The same year that the VEA was passed, ushering in major changes across the nation to Industrial Arts programs, Buffalo State made a significant contribution to its Industrial Arts program with the completion of Daniel Sherman Upton Hall, named in honor of Dr. Upton. Previously, the Industrial Arts department was located in Ketchum Hall (Dr. Louis Callan Oral History Tape, 1978).

A new industrial and fine arts building had been needed for years and construction was originally planned for 1954 (New Building at BSTC To Be Largest, 1954, p. 24). However, construction was delayed and groundbreaking ceremonies did not take place until October 18, 1960. The \$3.35 million structure, designed by Kideney Architects, was constructed to house the college's industrial and fine arts programs. The new four-story, 194,400-square foot building was designed to house 62 major

classrooms, shops, studios, and a 400-seat theater. The exterior of the building is faced with red Virginia brick combined with gray limestone and aluminum paneling faced with charcoal-gray baked enamel. The new building was initially occupied on a limited basis during the summer session 1962, one year in advance of its scheduled completion due to excellent weather, availability of materials and labor. Mrs. Robert D. Wickham, chairman of the college's local council, announced in 1962 the building would be named for Dr. Daniel Sherman Upton in "honor of the third principal of the Buffalo State Normal School" (Official Names Given to Seven Buildings at State College, 1962, p. III52). The building was formally dedicated as Daniel Sherman Upton Hall on April 24, 1963, at the beginning of Buffalo State College's five-day Dedication Week program (Celebrations Will Hail Growth of Facilities at Buffalo State, 1963, p. 25). Participating in the dedication ceremony of Upton Hall was Andrew W. Grabau, the 1915 Buffalo Normal School class president (when Dr. Upton was principal) and who attended the dedication of a bronze plaque to Dr. Upton in 1926 (State College Plans 5 Day Celebration, 1963, p. 17). Grabau's attendance was particularly fitting, for when Dr. Upton passed away in 1918, there was a movement afoot to name the Normal School and Technical High School in his honor, but the building was instead named for Grover Cleveland. Dr. Boocock, in delivering Upton's eulogy, surely reflected the thoughts of many when he said "some of [Upton's] friends have ventured to hope [his accomplishments] might lead the citizens of Buffalo to honor his work and his memory by giving his name to this school; and in addition to the Normal School, which he received as a heritage from noble workers who preceded him and which he developed into twice its former size and into enlarged usefulness, and in co-operation with others,

erected the splendid structure which is an ornament to the city and a credit to the State” (Boocock, 1918, p. 2).

*2.2.2.5.4 Digital applied learning technology developments.* In early 1964, just months after the VEA was passed and the completion of Buffalo’s Upton Hall, another significant development occurred in New Hampshire that would herald in the use of computer technology in applied learning at colleges during the next decade. In May 1964 at Dartmouth College, professors John G. Kemeny and Thomas E. Kurtz transformed the role of computers in education from primarily a research activity to an academic one. They developed a new, easy-to-use computer language called Beginners All-Purpose Instruction Code (BASIC) for use in universities to train programmers (Molnar, 1997, The Early Pioneers section, para. 1). BASIC, in many ways, bridged the gap between theory and learning-by-doing, which was the basic tenant of applied learning that had been so instrumental in the appeal of Industrial Arts. BASIC was close enough to a theoretical algorithm that a programmer could actually follow the reasoning of the machine as it made choices and followed logical pathways (Brin, 2006, para. 21).

*2.2.2.5.5 National trends in technology education changes during the 1960s.* After the federal policy changes of the early 1960s, it was during the mid-to-late 1960s that Industrial Arts education began to be modernized. Leading the charge were Industrial Arts educators within the SUNY system, and Oswego again played a significant role. Dr. Paul W. DeVore was influential in Industrial Arts education from the 1950s through the 1990s. DeVore became a member of Oswego State College faculty in 1956 and was made Director of its famed Industrial Arts program in 1960. In 1964, Dr. DeVore wrote the influential book *Technology: An Intellectual Discipline* in

which he proclaimed all forms of technology needed to be the center of an Industrial Arts education. DeVore organized the curriculum around seven major areas of technological endeavor, the areas that identify humans as a: (1) builder, (2) communicator, (3) producer, (4) transporter, (5) developer, (6) organizer and manager of work and (7) craftsman (DeVore D. P., 1964, p. 14). Other scholars in the field, such as Dr. William Everett Warner, had been calling for technology to be the basis for industrial arts since the 1940s. Warner focused on technology as mastery of the most prevalent industrial crafts of the period and the related methodology, tools and skills. However, it was DeVore who further refined and developed the ideas of modern technology integration into the traditional Industrial Arts field. DeVore published another influential book, *Technology: an Introduction* in 1980. This work sought to introduce college level Industrial Art students to the field of technology. With this textbook, DeVore sought to create a technology curriculum appropriate to the post-industrial era. DeVore said during the industrial era: “there was blind faith in the creation, development, and use of almost any new technical means” (DeVore D. P., 1980, p. xi). The purpose of the new text was to prepare America’s youth to “intelligently direct and use technical means to create a more humane future” (DeVore D. P., 1980, p. xii).

By 1966, DeVore had refined his seven-prong technology/industrial arts approach to just three essential components: production, communication, and transportation. Production included goods, services, manufacturing, and construction. Communication included information use, electronic communication devices including telephones, radio, televisions and computers. Transportation included the movement of man, materials, products and services.

DeVore refined the original three nineteenth century Manual Training/industrial tracks for the twentieth and twenty-first centuries. The original tracks were:

1. Object learning;
2. Tool instruction; and
3. Cultural education.

In contrast, DeVore adapted these for a post-industrial society:

1. Craft or trade approach, devoted to occupational/vocational goals;
2. Industry approach, with focus on the study of production elements of industry in America; and
3. A technology approach, programs which evolved from man as creator of technology. The approach incorporates the fundamental technical and cultural elements of technology.

The technology education he proposed was intended to be universal; an education for citizenship and preparation for participation in societies' technological evolutions.

DeVore was not focused on training people with technical skill; what he was concerned with was technical literacy. He was focused on endowing people with a sufficient understanding of technology so they will be able to make informed decisions on which technologies are beneficial, and have low negative impact (Kassel, 2005, p. 11).

***2.2.2.6 Evolution of Buffalo State College from a teacher's college to applied learning college.*** There were significant changes that occurred in Buffalo State's technology education during the mid-to-late 1960s which formed the foundation of its current technology programs. Since its inception, the Vocational Industrial/Industrial Arts program at Buffalo State was fortunate to have only a few directors during its period

of initial growth, and during the twentieth century when sweeping technology changes and their associated educational responses occurred.

*2.2.2.6.1 Faculty changes during the 1960s.* From 1910 until 1918, Dr. Upton had an able corps of directors who worked to create Buffalo State's Vocational Industrial program; during 1919-1920 the influential Oakley Furney was its director, and from 1920 until 1953 the program enjoyed the able leadership and lengthy tenure of Irving Perkins. During the next decade, Buffalo State's Industrial Arts program was directed by Dr. Kenneth W. Brown from 1953 until 1964.

Brown had the good fortune of being Industrial Arts program director when visionary professor Victor Joseph Papanek (1923 – 1998) taught courses in industrial design at Buffalo State. Papanek was faculty member of BSC's art department from September 1959 until June 1962 as well as advocate for socially and ecologically responsible design of products, tools, and community infrastructure (State University of New York College of Education at Buffalo, 1961, p. 24). Papanek had a wide array of educational experiences before his tenure at Buffalo State, including an apprenticeship with architect Frank Lloyd Wright during 1948-1949. Papanek fostered creative thought in classes he taught while at Buffalo State and said "the one way to get back to a student's creativity is to give him a problem totally unrelated to any previous experience of his" (Fruchtbaum, 1959, p. A8). A world traveler born in Austria, Papanek was the author or co-author of eight books, the most famous of which is *Design for the Real World -- Human Ecology and Social Change*, originally published in 1971 and since translated into 23 languages (Famous design book revised for new edition, 2000, p. K3). While in Buffalo, Papanek hosted a television program, *Design Dimensions*, on WNED



which helped to promote Buffalo State's programs to the public (Channel 17 Highlights, 1962, p. 11).

In 1964, Dr. Sherman F. Dreyer joined Buffalo State College as director of Industrial Arts education. In 1966 Dreyer was named dean of the College's Applied Science and Technology Division even as he continued to serve as the department chair for Industrial Arts and Vocational Technical education (Dr. S. F. Dreyer is Named Dean, 1966). Dreyer served as dean until 1976 and presided over the development of five new technology programs created at Buffalo State (LaHood, 1972, pp. 59-61).

There were many changes in store for Buffalo State's technology program offerings during the decade between 1963 and 1974. The first significant change in its Industrial Arts program occurred in 1963 with the proposal for Bachelor and Master of Science degree programs in Vocational Industrial Education. The programs were renamed Vocational Technical Education when approved a year later. Dr. Walter J. Zimmerman, a Buffalo State Vocational Industrial program alumnus from the class of 1926, was the director of the new vocational education programs (New Program, 1964, p. 10).

*2.2.2.6.2 Buffalo State technology education programs during the 1960s.* With the creation of the new programs in 1963, there were two comprehensive technology education programs at Buffalo State College: Industrial Arts Education and Vocational Technical Education. Graduates of the Industrial Arts Education Division received a Bachelor of Science in Education degree and were certified to teach Industrial Arts in elementary and secondary schools of New York State. The program involved the application of scientific knowledge to the creation and utilization of energy, materials,

and human resources. The curriculum included the tools, materials, processes, products, and occupations of principal industries. Basic courses were required in drafting, metal, textile, graphic arts, electricity, wood, ceramics, and transportation. Advanced elective courses permitted concentration in two or more areas. The graduates of the program taught students in public and adult education programs about industry: how it was organized; how it operated; its tools, materials, processes, products, occupations and the problems of life it creates. They also taught students about the intelligent use of industrial goods and services. In addition to the Bachelor of Science in Education degree, the program also offered a Master's degree, inaugurated in 1947. Buffalo State was authorized to offer its first Master's degree in general elementary education in 1945. Unlike its undergraduate programs, graduate classes were offered with fees: initial tuition during the 1940s was \$10 for each credit hour (Buffalo State Announces Advanced Degree Courses, 1947, p. 28).

The new Vocational Technical Education program, formerly known as the New York State Vocational Industrial teacher training program, had three levels: basic teacher certification, a Bachelor of Science degree, and Master of Science degree. The basic certificate program prepared graduates to teach Vocational Trade Shop in the public Vocational and Technical High Schools of New York State, correctional institutions, technical institutes, and community colleges (State University of New York College at Buffalo, 1964, p. 275).

*2.2.2.6.3 Creation of Buffalo State Industrial Technology program.* The next phase in Buffalo State College's technology development was its historic creation of five baccalaureate non-pedagogical technology programs, led by Dr. Myron E. Lewis who

joined Buffalo State College in 1962. In January 1969 Lewis ushered in the first of these programs, a Bachelor of Science degree in Industrial Technology. In addition to the program, a new Industrial Technology department was created and Lewis became its first chairman. The new program was consistent with the principles of Industrial Arts and was designed to educate students for positions in industry that required technical competency, managerial ability, and a broad liberal arts background. According to Buffalo State College president Dr. E.K. Fretwell, the new Industrial Technology program was designed to “draw upon principles and theories of the physical sciences, mathematics, and the technology of industry, and applies these to problems involving production, manufacturing, marketing, and the organization’s management and supervision of personnel involved” (New Industry Degree Course Is Announced, 1968, p. 8).

Inaugural faculty members of Buffalo State’s Industrial Technology department extended the program’s influence beyond Western New York when several of them became active participants in the formative activities of the National Association of Industrial Technology (NAIT), now the Association of Technology, Management and Applied Engineering (ATMAE). NAIT’s first conference was convened by Dr. Charles W. Keith, coordinator of Industrial Technology at Kent State University on October 29-30, 1965 to address the need for formalized industrial education curricula as universities realized their industrial arts graduates often pursued careers in industry rather than teaching (Keith, 1986, p. 1).

As a response to these national trends, it seemed natural that an Industrial Technology program would evolve from Buffalo State’s Industrial Arts program. Buffalo State’s Industrial Technology program received its initial accreditation from

NAIT in 1977 (ATMAE, 2011). BSC's Industrial Technology program later evolved into two options, each with a separate focus on: 1.) manufacturing; or 2.) quality. The manufacturing option evolved from the original Industrial Technology curriculum established in 1969. The quality option was developed to address the technological needs of contemporary industry. The Industrial Technology quality option program was approved in December 1993 by the Faculty Senate and was implemented in September 1994 (Meeting National Needs. A Dynamic Analysis of the Industrial Technology Program SUNY/College at Buffalo, 1994, p. 17).

*2.2.2.6.4 Creation of Buffalo State engineering programs.* With the precedent of the non-teacher Industrial Technology program established, in 1971, Dr. Lewis initiated three new significant Bachelor of Science technology engineering programs at Buffalo State: 1.) Electrical Engineering Technology: Electronics; 2.) Electrical Engineering Technology: Power and Machines; and 3.) Mechanical Engineering Technology. In 2011, the Electrical Engineering Technology: Power and Machines program was renamed Electrical Engineering Technology: Smart Grid. The program's foundation was based on electrical generation, distribution, and consumption. The program's present focus includes electrical power and machines in the whole interrelated dynamic system commonly referred to as the smart grid. The Technology Department is a consortium partner for a grant by the Department of Energy. Objectives of this \$2.5 million initiative include the development of smart grid minors, tracks, and concentrations (Buffalo State College, 2011, para. 3).

These engineering programs, in addition to Industrial Technology, were initially designed as 2+2 programs targeted to graduates of community colleges who wished to

continue their education (although qualified freshmen students were also admitted).

Students who graduated from an articulated community/junior college program admitted into the associated BSC program as a junior-level student. Since the 2+2 students had a proven track record and interest, it was anticipated the program would have higher graduation and retention rates compared with those that rely upon unproven freshmen.

Both the Electrical and Mechanical Engineering programs were accredited by the Accreditation Board for Engineering and Technology in 1983 (ABET, 2011).

**2.2.2.7 Industrial Arts Concepts Applied to the Digital Age.** Since the mid-twentieth century, Industrial Arts technology education programs have responded to the extraordinary growth of digital technology following World War II. Its impact can be summarized by the visionary Industrial Arts professor Dr. Paul DeVore:

The introduction of the first true electronic computer in 1946 . . . ushered in a new era of technology as significant as the introduction of the steam engine in the 1700s. The steam engine was an energy conversion machine; the computer is an information processing machine. The control and processing of information in a technological society has become as important as the control, conversion, and utilization of energy” (DeVore D. P., 1980, p. 209).

Dr. DeVore continued by describing the utmost significance of information systems technology: “The fusing of computer technology and communication technology gave birth to information-systems technology, a new technology which has altered and will continue to alter the very existence of humankind . . . more than any other technical development in the past.” He concluded by saying digital technology developments since 1946 have become “an integral part of society to such an extent that the society could not function without them” (DeVore D. P., 1980, pp. 265-266).

*2.2.2.7.1 Origin of digital technology education at Buffalo State and the Buffalo Technical High School.* The evolution of Industrial Arts programs and their integration with digital computer technology can be evidenced by two institutions that trace their technology lineage to Manual Training concepts of the nineteenth century: Buffalo State and the Buffalo Technical High School. Buffalo State College began to offer computer science classes in the mid-1960s as elective courses within its business and mathematics departments. The classes were taught by Professor Rudolph Meyer, who joined Buffalo State College in 1965. The College's first computer laboratory was created in 1966. It contained an IBM 1130 computer, designed for the educational market. (The Computer Era Comes to Buffalo State, 1966, p. 53). A successor to the IBM 1620 computer, disk memory was used to store the operating system, object code, and data; however source code was stored on punched cards.

Several years before Buffalo State introduced its computer classes, Hutchinson Central Technical High School (the current name of the Buffalo Technical High School started by Daniel Upton at the turn of the twentieth century), also expanded its curriculum to incorporate digital computing technology. The high school has always strived to keep its curriculum current with technical developments (Allen C. , 1965, p. P2). Nationally, Hutchinson Central Technical (Hutch Tech) was a digital computing educational pioneer. It acquired an IBM 1620 (Level C) computer in 1961, believed to be the first high school in the United States to incorporate a computer within its curriculum and among the first in the world (Dibble, 1969, p. 51).

The computer was integrated into engineering courses that required advanced mathematic analysis. Classes were taught in assembly language, symbolic programming,

Fortran, COBOL, and numerical analysis. Significantly, the computer curriculum was sponsored by the National Defense Education Act in cooperation with the Buffalo Board of Education. By 1965, the computer was used by 200 high school students and approximately 60-70 adult education students each year ('Subject' at Hutch Tech Also Provides Answers, 1965, p. 26). By 1969, Hutch Tech's computer program was a solid success and its original computer was replaced with an updated IBM 1130, the same type used at Buffalo State. In September 1969 a new four-year high school course in computer technology was instituted at Hutch Tech with specializations in computer programming or computer science/electronics.

Interestingly, in the nearly ten years the computer had been in use at the high school, Robert Santuci, Hutch Tech's computer program director since 1961, changed his criteria for a successful computer technology student. In the early 1960s, he believed student mathematics proficiency was paramount. By the end of the decade, Santuci believed successful computer students had to have proficiency in the following, in order of importance: 1.) logic and order; 2.) creative and investigative skills; 3.) English; and 4.) mathematics (Dibble, 1969, p. 51).

The historic computer initially installed at Hutch Tech was a punch-card based IBM model 1620. It was announced by IBM on October 21, 1959 as a relatively inexpensive scientific computer. IBM produced about 2,000 of the computers. Being variable word length decimal, as opposed to fixed-word-length pure binary, made it an especially attractive first computer to learn, and hundreds of thousands of students had their first experiences with a computer on the IBM 1620 (Zannos, 2002, p. 19). Modified versions of the 1620 were used as the CPU of the IBM 1710 and IBM 1720 Industrial

Process Control Systems (the first digital computer considered reliable enough for real-time process control of factory equipment). The successor to the 1620 was the IBM 1130, the basis of Buffalo State College's initial foray into computing technology in 1966 and also later used at Hutch Tech.

*2.2.2.7.2 Creation of Buffalo State's Information Systems Management program.*

In response to the successful computer curriculum programs at Buffalo State and Hutch Tech as well as the emerging importance of information systems technology, Dr. Lewis created his final new technology program at Buffalo State: a Bachelor of Science computer technology program called Information Systems Management (ISM). The program (now known as Computer Information Systems), is believed to be the first of its kind in the United States when it was created in 1974.

The ground-breaking ISM program was designed by Dieter Jungclaus, the Associate Dean of Buffalo State's Applied Science and Technology Division. The program's key instructors, in addition to Meyer (who became Director of ISM), were Irving Sherman and Ernest G. Zavisca. The program was designed to prepare students for employment in the computer field, but much more broadly than the traditional computer science program. The ISM program was designed to satisfy a need for personnel with competencies to manage computer science projects or centers, as well as computer and data processing installations. The program was under the management of the Buffalo State's Technology Department until its own department was created in approximately 1985 (Buffalo State College, 1985, p. 76). The program was renamed Computer Information Systems about 1990 (Buffalo State College, 1991, p. 46).



*2.2.2.7.3 Digital computers as an applied learning model.* At the same time Buffalo State College was entering the computer age in instructional programming, influential work was also taking place on a national level intended to make computers the center of an applied learning model. The most exciting work during this period was by Dr. Seymour Papert (born 1928) from MIT who developed and implemented constructivist educational theories. Formalization of the theory of constructivism is generally attributed to Jean Piaget (1896 - 1980), a Swiss developmental psychologist and philosopher who articulated mechanisms by which knowledge is internalized by learners. Closely related to the theories of Della-Vos, Runkle, Pestalozzi, Sheldon, and Woodward before him, Piaget suggested through processes of accommodation and assimilation, individuals construct new knowledge from their experiences. Constructivism is a theory describing how learning happens, regardless of whether learners are using their experiences to understand a lecture or constructing a model airplane. In both cases, constructivism suggests students learn by constructing knowledge out of their experiences. While constructivism may be applicable to both theoretical and applied learning, is often associated with pedagogic approaches that promote applied learning, or learning-by-doing (Wertsch, 1985, p. 47).

Papert worked with Jean Piaget during the 1960s, considered to be the most brilliant and successful of Piaget's protégés. Papert said “constructionism’s line of direct descent from the soap-sculpture model is clearly visible” (Papert & Harel, 1991, p. 6). In 1967, Papert, in conjunction Daniel G. Bobrow, Wally Feurzeig, and Cynthia Solomon developed the Logo computer programming language in 1967 for educational use,

specifically for constructivist teaching. By the 1970s, Logo soon became the language of the elementary school computer literacy movement (Papert D. S., 1980, p. xvii).

To further promote his computer-based applied learning theories, Papert extended Logo to work with Lego construction kits. Papert asserted learning is more effective when the student constructs a meaningful, tactile product. In building computer-driven Lego constructions, the student learned to define a problem and the tacit practical problem-solving skills needed to solve it (Molnar, 1997, Micro Worlds section, para. 1-3). In this way, the Logo/Lego is an example of a modern digital descendent of the Manual Training exercises of a century before.

**2.2.2.8 Gender impact on new Buffalo State technology programs.** While the five new technology programs created at Buffalo State between 1969 and 1974 were created during a time of increased gender diversity, the programs were, nonetheless, dominated by males. With the exception of vocational dressmaking, it took 35 years for Buffalo State's original Vocational Industrial program to produce its first female graduate. While the five new technology programs created between 1969 and 1974, didn't take as long to produce their initial female graduate, each of the programs took several years. Started in 1969, the Industrial Technology program's first female graduate was in 1977. Of the two technology programs started in 1971, Electrical and Mechanical Engineering, each of the programs had their first female graduate in 1978. Ironically, of the five new technology programs discussed here, it was the most recent program, Information Systems Management (started in 1974), that had its earliest initial female graduate, in 1976.

### ***2.2.2.9 The Future of Technology Programs at Buffalo State College.***

Consistent with the national trends of evolving technology and names, Buffalo State College's Industrial Arts and Vocational Education Department was renamed to the Technology Department in January 1984. The Industrial Arts Education program was renamed Technology Education (the last time the program was referred to as Industrial Arts in the BSC catalog was 1985-1987). The Vocational Technical Education program was renamed Career and Technical Education (the last time Vocational Technical appeared in BSC course catalogs was 1999-2001). The Vocational Technical Education program had been previously moved from the Technology Department to the Educational Foundations Department about 1997 (Buffalo State College, 1997, p. 128). The Technology Education program is accredited by the National Council for Accreditation of Teacher Education (NCATE). Buffalo State received its initial accreditation from NCATE in 1954 and BSC's Technology Education program is a nationally recognized program through NCATE's specialty accreditation organization, the International Technology and Engineering Educators Association (National Council for Accreditation of Teacher Education, 2010, Technology Education section).

*2.2.2.9.1 Anticipated impact of new Technology Building expected to be completed in 2013.* Just as Buffalo State College displayed its commitment to technology education fifty years previously in the midst of technology education legislative changes with the construction of Upton Hall, the college continues to display its commitment to technology education during national STEM enrollment challenges during the twenty-first century. The college's continuing commitment to its technology curriculum can be evidenced by its \$38 million Technology Building constructed during 2011-2013. The

building is significant as it will house Buffalo State College's Technology and Computer Information Systems departments. The building was designed by The S/L/A/M Collaborative of Glastonbury, Connecticut to have a striking exterior clad in a blend of metal panels, a glass curtain wall, and masonry. The three-story, 87,000-square foot building will feature smart classrooms and multimedia labs. Also included within the design of the building is one 60-seat lecture hall and one 36-seat classroom, as well as two 24-seat classrooms that can be combined to accommodate 48 students. Spaces will be integrated and easily reconfigured to accommodate new technology and evolving curricula. The Technology Building will be built to Leadership in Energy and Environmental Design (LEED) silver standards, and incorporate many green environmental features, including an energy-efficient roofing system, high-performance glazing, and photovoltaic panels. The Technology Department shops and labs will be housed on the first floor, labs for the Computer Information Systems Department on the second floor, and space for the Fashion and Textile Technology program will be housed on the third floor (Buffalo State College Relations Office, 2011, p. 3).

Groundbreaking for the building occurred on June 10, 2011 and it is anticipated the building will be completed in August 2013. At the groundbreaking ceremony, speakers included: Dr. Stan Kardonsky, BSC Vice President for Finance and Management; Dr. Kevin F. Mulcahy, BSC Interim Dean, School of the Professions; Dr. Richard A. Stempniak of the BSC Technology Department, Melissa Brinson, of the BSC College Council; Mark Grisanti, New York State Senator (R-60); Sam Hoyt, New York State Assemblyman (D-144); and Dr. Aaron Podolefsky, BSC President. The construction manager is LP Ciminelli and general contractor is Manning Squires &

Henning Inc. of Rochester, New York (Buffalo State College, 2011, para. 5). Dr. Stan Kardonsky noted the groundbreaking was the culmination of nearly 20 years of planning work. After working for years to procure the funding through the Western New York State of New York legislative delegation, the funding was obtained but directed to the wrong agency, the Urban Development Corporation. It then took an additional five years to transfer funds from the Urban Development Corporation to the State University of New York. Buffalo State College also had to acquire the property, which contained two buildings known as the bakery and laundry; they were remnants of old Buffalo Psychiatric center. With all those precedent accomplishments complete, the construction activities could then commence (Buffalo State College Technology Building Ground Breaking Ceremony, 2011). Buffalo State President Aaron Podolefsky said the new technology building “will facilitate greater collaboration between the people of Buffalo State and our community partners — it will be a home worthy of their visionary pursuits and cutting-edge experiments” (Rey, Tech building work begins today, 2011, p. D2).

After the Technology Department moves to the Technology Building, Upton Hall, which was home to the Technology Department for half a century, is planned for a significant repurposing. The first phase of construction, designed by Flynn Battaglia Architects, is expected to cost \$42.6 million, begin in the autumn of 2013 and be complete by the summer of 2015. The renovated Upton Hall will provide classroom, lab, studio, and office space for departments in the School of Arts and Humanities (Buffalo State College Finance and Management Office, 2012, para. 1).

*2.2.2.9.2 Technology program challenges.* While the evolution and development of four-year technology programs at Buffalo State College has been significant, there

remain challenges to be solved as the programs continue to evolve. One of the challenges is to create a homogeneous program curriculum. Since the advent of technology departments in the 1960s, there have been efforts to identify the body of knowledge required by students of technology-related occupations; and to develop curricula and courses to ensure all the important concepts are taught during the course of an undergraduate education in technology fields. While the array of technology has grown exponentially, the hours available to impart this knowledge in an undergraduate curriculum have remained constant (Meares & Sargent Jr., 1999, p. 72).

Nationally, four year technology programs have been criticized for being out-of-date and too slow to adapt curricula to changing technologies. The rapid pace of change in technology, especially information technology, has affected the content and delivery of undergraduate technology education. In addition, the lag may also be due, in part, to the complex and lengthy processes most universities have in place for developing, reviewing, and approving new curricula, some a result of self-imposed rules, others resulting from a complex accreditation process. Anecdotally, community colleges appear to be more adroit than four-year degree programs at adapting their curricula to the changing technology environment. Private for-profit institutions appear to be able to adapt most quickly to changing technology needs and opportunities (Meares & Sargent Jr., 1999, p. 79).

**2.2.3 National Decline in Technology Programs at Colleges.** Since the 1990s, there has been a sharp decline in enrollment in technology related programs including (but not limited to) computer science programs. The lessons applied to the baby boom generation during the 1960s do not seem to have been passed to the present generation,

but they still resonate with those who recall those years, including Senator John Kerry who said: “We need R and D, we need science, technology, engineering, math. We need to kick America into gear. This is our Sputnik moment. We’ve sort of seen Sputnik going across the sky, but we’ve done nothing similar to what we did in the 1960s to respond to it” (Kerry, 2010).

Sputnik was also referenced by President Barack Obama in his 2011 State of the Union address when he said:

Half a century ago, when the Soviets beat us into space with the launch of a satellite called Sputnik, we had no idea how we would beat them to the moon. . . . But after investing in better research and education, we didn’t just surpass the Soviets; we unleashed a wave of innovation that created new industries and millions of new jobs.

This is our generation’s Sputnik moment. Two years ago, I said that we needed to reach a level of research and development we haven’t seen since the height of the Space Race . . . . We’ll invest in biomedical research, information technology, and especially clean energy technology, an investment that will strengthen our security, protect our planet, and create countless new jobs for our people (Obama, *Our Destiny Remains Our Choice*, 2011, p. 102).

Nationally, the scope of the problem of declining enrollments in some technology fields is important. In a study published in 2001, the number of Industrial Technology graduates per year from 1988 until 1998 (the period of the study) decreased substantially. The trend is similar to what has occurred nationally in engineering, math, and computer science programs during the same period. It is not only enrollment in Industrial Technology that has declined during the period of the study, but also the number of Industrial Technology programs has decreased during the same period. This is even more surprising given that during the same period, the number of students availing themselves to higher education has increased, and is expected to continue to increase for the

foreseeable future. These students include more women, and larger numbers of both traditional and non-traditional students. The study noted a steady increase in the number of graduates of non-technical programs such as psychology, sociology, and history where job opportunities appear to be less favorable than technology programs. The study particularly called attention to the dramatic decrease in Industrial Technology enrollments at Buffalo State College. During the study period, enrollment dropped from 723 to 157 and the study recommended a “qualitative investigation involving interviews of various people . . . and focusing on the reasons for the declines may be helpful to industrial technology leaders” (Chang & Dugger, 2001, p. 6).

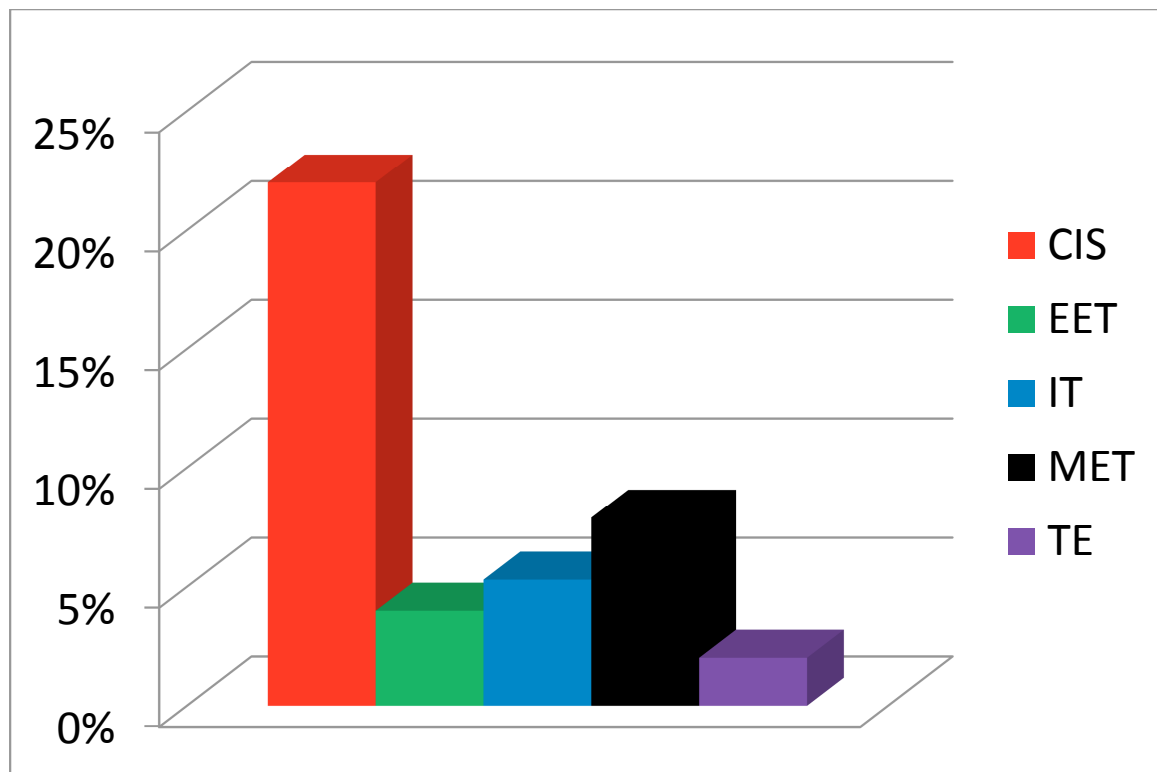
It appears as a consistent surprise to most researchers that at a time when salaries of technology professionals are rising, more students are not flocking to computer science and information technology programs, among other technology programs. Several studies have attempted to identify the source of these dramatic technology enrollment declines. One study suggested negative perceptions about technology careers coupled with a lack of understanding of the skills required for success in technology fields is a leading cause for the drop in enrollment. Negative stereotypical images of technology users may impact children’s choice of technology education and careers (Gupta & Houtz, 2000, p. 2). A more recent study, by Lenox, Woratscheck, and Davis (2008) found several common reasons for the marked decline in technology program enrollment including: 1.) the image of technology course attendees as being anti-social; 2.) the cyclic nature of demand on technology professionals; and 3.) the perception of technology jobs outsourced overseas (Ali & Shubra, 2010, p. 214).



While there are declining enrollments in certain technology programs at colleges, those same declines are not echoed in associated anticipated job growth. According to the United States Department of Labor Bureau of Labor Statistics, most of the job sectors related to Buffalo State College's technology programs within the scope of this study will enjoy growth through 2020; some especially so. However, due to the high number of retirees expected during the next decade, the total number of job openings due to organic growth and retirees is significantly higher. Of the total number of jobs associated with the scope of this study projected through the next decade, on average, nearly one in three will be opened to those new to the field. A list of relevant job projections can be found in Table 4 and aggregated in a bar chart shown in Figure 24.

**Table 4. United States Job Growth and Salaries for Applicable Job Sectors. Source: U.S. Department of Labor Bureau of Labor Statistics.**

<b>Job title</b>	<b>2010 Employment</b>	<b>Projected 2020 Employment</b>	<b>Net Growth</b>	<b>Replace- ment Growth</b>	<b>Median 2010 Salary</b>
Electrical engineers	154,000	164,700	7%	29%	\$84,540
Electronics engineers	140,000	146,900	5%	28%	\$90,170
Electrical and electronics drafters	29,200	30,800	5%	7%	\$53,020
Electrical and electronic engineering techs	151,100	154,000	2%	21%	\$56,040
Electro-mechanical technicians	16,400	16,500	1%	19%	\$49,550
Industrial engineers	203,900	217,000	6%	27%	\$76,100
Industrial engineering technicians	62,500	65,100	4%	22%	\$48,210
Mechanical engineers	243,200	264,600	9%	38%	\$78,160
Mechanical engineering technicians	44,900	46,700	4%	22%	\$50,110
Mechanical drafters	67,400	74,900	11%	27%	\$48,810
Computer systems analysts	544,400	664,800	22%	33%	\$77,740
Computer programmers	363,100	406,800	12%	31%	\$71,380
Computer software engineers	913,100	1,183,900	30%	31%	\$90,985
Computer support specialists	607,100	717,100	18%	38%	\$46,260
Database administrators	110,800	144,800	30%	36%	\$73,490
Network and computer systems administrators	347,200	443,800	28%	35%	\$69,160
Info systems analysts and network architects	302,300	367,900	22%	30%	\$75,660
Computer occupations, all other	209,700	222,000	6%	23%	\$79,240
Computer hardware engineers	70,000	76,300	9%	30%	\$98,810
Career/Technical education teachers	103,000	105,300	2%	28%	\$52,890



**Figure 24. Aggregation of projected U.S. job growth through 2020 for sectors relevant to six academic technology programs within scope of study.**

The positive projected job growth for the six program areas within the scope of this study is echoed by these programs' performance in associated jobs during the Recession of 2008. A 2011 study conducted by Georgetown University examined national unemployment rates for graduates of specific college programs. The study found the six technology programs within scope of the present study had much lower unemployment rates for graduates with experience in their field compared to overall unemployment averages. Graduates of the six technology programs within the scope of this study had an unemployment rate between 3.8 and 5.4 percent, compared with overall national averages of nearly ten percent. The study evaluated data from the American Community Survey for the years 2009 and 2010 (Carnevale, Cheah, & Strohl, Hardtimes. Not all College Degrees are Created Equal, 2011). The unemployment rates from the

study are graphed in Figure 25 (Technology Education is represented by a category called Miscellaneous Education).

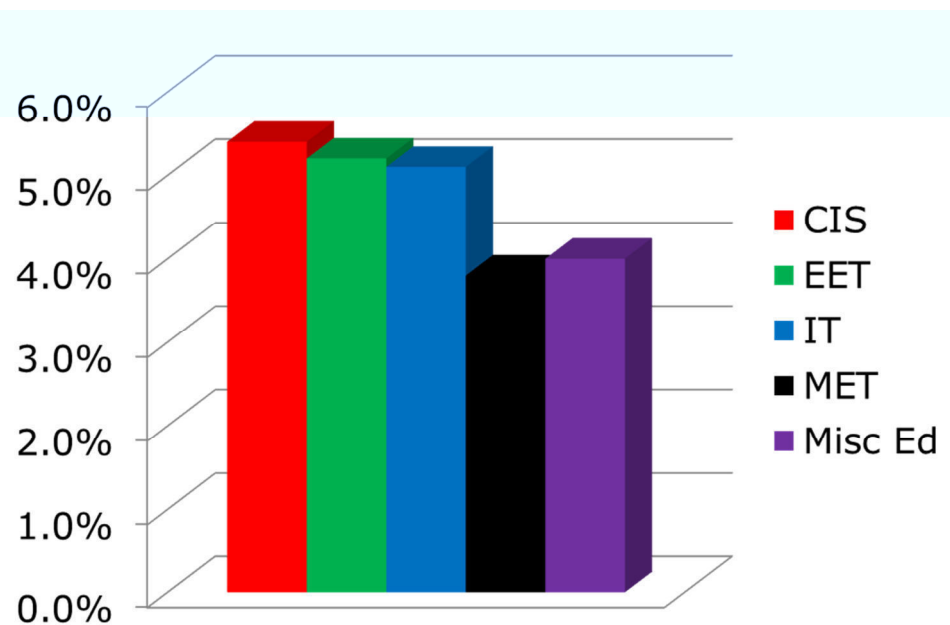


Figure 25. 2009-2010 National unemployment rates for six programs in this study are much lower than national averages of nearly ten percent. *Georgetown University.*

While projected job growth, good salaries, and low unemployment rates during a recession would typically be viewed as catalysts for enrollment in baccalaureate postsecondary programs such as the six technology programs within the scope of this study, there remain factors which may discourage students from enrolling in those programs. Another factor that may be negatively influencing enrollment specifically in four-year technology programs is the perception for some of the jobs available over the next decade, a four-year degree may not be a requirement. A 2005 National Association of Manufacturers report found while 35 percent of manufacturers anticipated a shortage of scientists and engineers, more than twice as many respondents anticipated a shortage of skilled production workers, needed for middle-skill jobs that require more than a high school but not a four-year degree (Wilczynski, 2011, p. 12).

Enrollment in at least one college program and its related career choice at Buffalo State College may be negatively impacted by policies set by New York State as it relates to Industrial Arts/Technology in primary and secondary grades. Classes in technology are required for grades seven and eight, but are optional for grades nine through twelve. There is growing discussion in the academic and business community that career counseling must start in the early school years, in fact, as early as elementary school (Gupta & Houtz, 2000, p. 6). Since children are more open-minded and malleable in their early years, education that may lead to careers should start in elementary school, with special programs to attract girls into science and engineering disciplines, as this is a time when many girls drop out of math and science (Sacks & Mergendoller, 1994).

**2.2.3.1 National response to decline of postsecondary college enrollment in STEM programs.** In 2005, the report *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Future* (Committee on Science, Engineering, and Public Policy, 2007) was completed. Commissioned by two senators, Lamar Alexander (R-Tennessee) and Jeff Bingaman (D-New Mexico), the report was complimented by a follow-up: *Rising Above the Gathering Storm Two Years Later: Accelerating Process toward a Brighter Economic Future* (Committee on Science, Engineering, and Public Policy, 2009). Through these reports and an editorial published in the *New York Times*, an urgent need was advocated for United States' STEM education in the twenty-first century. The editorial stated Americans, if assembled for a national discussion, would likely ponder the phenomenon in which American manufacturers are moving to find lower wages, better infrastructure and cheaper health care, and why in recent years U.S.

industry appears to have spent more on lawsuits than on research and development (Friedman, 2005, p. A25(L)).

*Rising Above the Gathering Storm* cautioned American “workers in virtually every sector must now face competitors who live just a mouse-click away in Ireland, Finland, India or dozens of other nations whose economies are growing” (Committee on Science, Engineering, and Public Policy, 2007, pp. 1-2). The report made four recommendations to mitigate the loss of key jobs to foreign countries:

- Increase America’s talent pool by vastly improving K-12 mathematics and science education;
- Sustain and strengthen U.S. commitment to long-term basic research;
- Develop recruit and retain top students, scientist and engineers from both the U.S. and abroad; and
- Ensure the United States is the premier place in the world for innovation.

As a result of the report, the U.S. government passed the bipartisan Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act in August, 2007. Among other initiatives, the Act emphasizes the importance of undergraduate research as a tool to promote careers in STEM fields. While the COMPETES Act acknowledges the importance of the report, it remains to be funded.

Part of the challenge is determining how Americans can increase their STEM literacy. One suggestion is STEM academic courses should teach a generalized technology approach and teach students to be:

- Problem solvers
- Innovators
- Inventors

- Self-reliant
- Logical thinkers
- Technologically literate

Many of these objectives are consistent with Dr. Paul DeVore's new vision of a technologically-based Industrial Arts program, put forth decades before. The engineering component of STEM education puts emphasis on the process and design of solutions instead of the solutions themselves. The technology component allows for a deeper understanding of the three other components (science, engineering, and mathematics) of STEM education. It allows students to apply what they have learned, utilizing computers with specialized and professional applications like Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) and computer simulations and animations (Lantz, 2009, p. 3).

**2.2.4 The growth of professional certification education.** Within the last 25 years, two related technology education options have arisen for technology students: for-profit distance-based technology education and professional certifications. Voluntary certification is used in a variety of professions to indicate quality and currency. Most technology fields do not require state licensure; therefore, voluntary certification has emerged as a method of ensuring and signaling the skill level of technology workers, and to a lesser degree, may serve as a substitute for some level of experience or education.

Certifications are earned from a professional society or product vendor and, in general, must be renewed periodically (typically every three years). As a part of a renewal of a professional certification, it is common for the individual to show evidence of continued learning in the form of professional development or continuing education units.

The growth of certification programs may be a reaction to the changing employment market. Certifications are portable, since they do not depend on one company's definition of a certain job. On a resume, certifications often replace the professional reference by being an impartial, third-party endorsement of the job candidate's professional knowledge and experience.

In the computer information systems/information technology field, professional certification is especially popular. It is estimated that over 1,000 information technology certifications are available (Hunsinger & Smith, 2008, p. 248). Approximately 6.5 million people in the U.S. hold a computer-related professional certification; that number may exceed 20 million by 2010. Industry analysts estimated the size of the certification training market in North America at \$500 to \$600 million in 2000, climbing as much as 20 percent per year for the foreseeable future. Worldwide spending in information technology certification alone was estimated to reach \$4 billion in 2003 according to an IDC report. The popularity of information technology certifications suggests many information technology professionals believe managers utilize them as a selection tool when hiring. According to one study, "Human resource managers have typically used information technology certifications as an indicator of an applicant's base-line suitability for a specific information technology related position. Certifications act as a signal to hiring managers that a job candidate has achieved a level of knowledge and skill necessary to perform in a particular IT job role" (Hunsinger & Smith, 2008, p. 248).

In his seminal study, *A Parallel Postsecondary Universe*, Dr. Clifford Adelman examined the rapid growth of professional certifications and made the following conclusions about their role in the educational and job hiring process:

- Professional certifications are global and operate in many languages;
- The postsecondary student, not the institution, is at the center of the system;
- Professional certifications have brought competency-based education, computerized adaptive testing, and performance assessment to a level they have never enjoyed within traditional higher education; and
- Certifications replace neither experience nor degrees (Adelman, 2000, p. vi).

Professional certifications relevant to the technology programs at Buffalo State College within the scope of this study are included in Appendix Five.

**2.2.4.1 Categories of professional certifications.** There are two general category types of professional certifications within the scope of this study. They are: vendor-neutral (profession-wide), and vendor-specific. Vendor-neutral certifications have been in existence for several decades, although vendor-specific certifications have driven the current change in scope, assessment and impact to postsecondary college curricula.

**2.2.4.1.1 Vendor-neutral certifications.** The most widely-known and accepted type of certification is the profession-wide, also referred to as vendor-neutral certification. In order to apply professional standards and increase the level of practice, a professional organization often establishes a certification program. This is intended to be portable to all places a certificant might work.

Many vendor-neutral certification programs are created, sponsored, or affiliated with professional associations and trade organizations interested in raising professional standards. For example, the Society of Manufacturing Engineers offers the Certified Manufacturing Engineer (CMfgE), a program in which a candidate must demonstrate a comprehensive knowledge of manufacturing processes and practices. Pursuing a CMfgE certification requires a minimum of eight years of combined manufacturing-related



education and/or work experience, including a minimum of four years of work experience.

While some vendor-neutral certifications are relatively new, the organizations themselves might be over a century old. For example, the American Management Association (AMA), a nonprofit organization focused on experiential business learning was founded in 1913, the same year South Buffalo native Russell N. Keppel was class president of the Buffalo Normal School. After graduating from the Buffalo Normal School's Vocational Industrial program in 1914, continued his education by studying law at the University of Buffalo and passed the bar. He also studied at Columbia University (Russell N. Keppel Former Resident of South Buffalo, Dies, 1968). After serving in the submarine corps during World War I, Keppel became personnel manager for Bayonne Refinery, Standard Oil Company of New Jersey. Keppel was very active in the AMA and on June 8, 1928, Keppel returned to Buffalo to deliver a paper, *Training Manual Workers*, at the Production Executives' Conference held at the Hotel Statler. Keppel attempted to address the needs of preparing workers for jobs using a variety of educational tools and notes "manual workers secure more education and training within the gates of industry than within the walls of schoolrooms though few diplomas and no degrees are granted" (Keppel, 1928, p. 3). Although professional certifications were not prevalent at that early date, Keppel foreshadowed their future development with his promotion of what he termed preliminary, or vestibule training. Today, many nonprofit, membership-based organizations, referred to within this study as vendor-neutral certifications, now offer professional certifications within certain areas such as vestibule

training. In AMA's case, a Myers-Briggs Type Indicator certification program is offered, among others (American Management Association, 2011).

*2.2.4.1.2 Vendor-specific certifications.* This type of certification, intended to show mastery of a technical vendor product, is very prevalent in the information technology industry where personnel are certified on a type of software or hardware. This type of certification is portable across locations (for example, various corporations which use a particular software program), but not across other products.

Vendor-specific certifications provide independent verification certificants have achieved a level of expertise or a specific set of skills and knowledge that relates to specific products or technologies. These certifications do not represent a multidimensional assessment of knowledge, soft and business skills, or experience. They are simply indicators of mastery of some specialized knowledge and are supplemental to formal degrees and work experience.

Preparing for these certifications often represents a significant investment in time and expense. Certification education required for assessments may be obtained through self-study, for-profit colleges, traditional four-year colleges, community colleges, or even secondary schools.

Many holders of professional vendor-specific certifications believe these programs provide them specific marketable skills and offer a way to quickly learn a new technology. They also believe vendor-authorized certification programs are current and in step with industry directions (Meares & Sargent Jr., 1999, p. 123).

Professional vendor-specific certifications can trace their origins to a company called Novell, Inc., who popularized the general concept of professional certifications to

create a program specific to their company to build market share and manage support costs (Shore, 2002, p. 1). The certification program it built not only created a homogeneous process that increased skill levels of individuals who worked with Novell's products, but in the process it created an entire new industry that had an immeasurable impact on the technology business as well as secondary and postsecondary technology curricula.

**2.2.4.2 Novell's pioneering certification program, distributed computing, and the Internet.** Several emerging technologies converged during the 1980s to serve as an impetus to create a professional certification program, whose effects, in turn, spawned an entire new technology education industry. The initial technology was the popular business use of microcomputers, also known as personal computers (PC) through International Business Machine's introduction of its PC on August 12, 1981. A significant supporting technology was the communication networking of PCs to accomplish business goals. The combination of PCs and networks is referred to as distributed computing.

Software used for the operating system of both PCs and the networks that connected them gave rise to many new businesses during the 1980s. These included Microsoft, (which produced the operating system for the IBM PC) and Novell, which produced NetWare, a popular operating system for microcomputer servers. Products from these companies allowed for the creation of PC networks, facilitating the sharing of electronic computing resources such as printers and disk-based storage.

Novell is no longer a leader as a technology brand, nor as a professional certification organization. However, as originator of computer-based professional

certifications, it is noteworthy within the scope of this study. Novell was the company that developed computer-based training and testing models that continue to be widely used by many current professional certification organizations across a broad array of technology disciplines.

Novell was founded in 1979, but it was not until 1983 that its flagship product, NetWare, was introduced. That same year Ray Noorda (1924 - 2006) was hired as Novell's Chief Executive Officer. While Noorda held a technical electrical engineering degree, his reputation was based on his being a business leader with a strong work ethic honed by living in impoverished Utah during the Great Depression. As a youth, he took jobs setting pins in a bowling alley, picking cherries, and even herding sheep.

With Noorda's technical and business skills fully deployed, Novell experienced exponential growth while he was CEO. Noorda transformed Novell from a company with 17 employees in 1983 into a company with more than 12,000 when he retired in 1995.

Noorda implemented two key business concepts at Novell that were to have significant impact on the development of professional certifications. The first was "coopetition," a term that Noorda coined to indicate alliances among technology competitors so common standards could be developed while at the same time growing the overall technology market.

The second key concept was the implementation of a two-tiered sales distribution channel model at Novell. The company sold its products to wholesale distributors or directly to value added resellers (VARs), who would in turn sell them to businesses. The two-tier sales distribution channel model continues to be widely in use today.

Distributors like Ingram, Tech Data and Synnex provide vital functions such as warehousing, training, technical support, and credit processing for product manufacturers (Crook, 2011).

For his contributions at Novell and the entire distributed computing industry, Noorda is known as the “father of network computing” (Connor, 2006, p. 12). Despite Noorda’s significant contributions to network computing, it may be his contributions to professional certifications that are his lasting legacy.

What began as an idea in 1987 eventually became the multi-billion dollar global professional technology certification enterprise of today. The genesis of the certification originated with Noorda and William Wall, of Novell’s sales department, who had an idea to develop an educational certification program that could help bolster sales. However, to make the idea a reality, it took the pioneering efforts of two individuals who performed seminal work in the field: Carolyn G. Rose and E. Clarke Porter, the “father of computer-based testing.”

Within Novell, its Education Division was responsible for its training materials and certification program. Augmenting Novell’s corporate mission, its educational mission was to accelerate the growth of network computing through quality education programs. The Educational Division’s purpose was to increase literacy on Novell products and technologies to foster Novell’s success worldwide.

Because Noorda wanted to grow the distributed computing business, he felt there should be an education program based on certifications of Novell’s products. Novell’s professional certification objective therefore was threefold and incorporated a: 1.) sales component; 2.) service component; and 3.) knowledge component. Noorda believed if

there were qualified individuals in the field providing excellent support for Novell's products, it would ultimately translate into higher sales.

Because of the success of the IBM PC (and clones from Compaq and many other companies) and distributed computing in general, there was an urgent need to train qualified technicians on Novell's products. The primary audience was VAR technicians and technical staff from large companies.

Among other accomplishments, Novell's Education Division pioneered the authorized training center model in the emerging computer professional certification business. New to Novell was the strategy to rely on the training organization to secure a facility and equipment. In 1987, Novell opened its Novell Authorized Education Centers (NAEC), a franchised model that worked with local training companies throughout the United States. The franchised NAEC model allowed Novell to develop standardized, high-quality training materials to global NAECs without having to staff direct training capacity (Shore, 2002, p. 2). NAECs were assured a demand for training because of NetWare's growing success.

While NAECs were successful, there were several issues. Although the NAECs trained students on Novell's products, initially there was no curriculum assessment to ensure an understanding of the technologies being taught. In addition, Novell had another problem because of NetWare's stellar success. Distributed computing was in its infancy and its complexity was not well understood. Still, NetWare and distributed computing was very popular with small companies and individual departments within larger companies because of the business benefits the technology afforded. Customers purchased NetWare directly from Novell or through VARs who were often not equipped

to provide high-quality and affordable post-installation support. Because of this, Novell had an urgent need to verify NetWare installers and administrators had the skills to support its often complex technical environment without relying directly on Novell for support. Novell's solution to this problem was to create a certification to accurately and honestly assess and validate the skills an individual needed to properly install and support NetWare (Shore, 2002, p. 2).

To address this problem, Carolyn G. Rose, Senior Vice President and General Manager of Novell Education at Novell from 1989 until 1997, was responsible for Novell's (and the information technology industry's) first certification launch in 1989, the Certified NetWare Engineer (CNE). To create the certification, skilled Novell experts detailed the skills and knowledge needed to perform key jobs related to NetWare. The skills were categorized into objectives and prioritized and questions were written for each objective that would become the basis for assessments (Shore, 2002, p. 2). When the program was developed, the CNE certification successfully provided a measurement or credential of the knowledge required to support distributed computing networks that incorporated Novell's products.

Considering the CNE certification was the computer technology industry's first of its kind, its name elicited controversy. Several states, including Illinois and Nevada, issued cease-and-desist orders to Novell because of the certification's use of the term engineer. These states claimed the public may confuse someone holding a CNE certification with a professional engineer. The states maintained professional engineers are defined as individuals who design, build, and maintain structures and include structural, mechanical and electrical engineers. However, Novell showed the use of the

term engineer is applied to many fields, such as locomotive, service and sanitation engineers who carry the title but do not practice professional engineering. In these cases where the states challenged Novell's CNE certification, the courts sided with Novell (Novell, Inc., 1999). The irony is not lost on Noorda, who approved of the Certified NetWare Engineer title, was an academically educated electrical engineer. Novell's precedent of use of the term engineer for information technology certifications was followed by other significant vendor-specific professional certifications such as the Cisco Certified Network Engineer (CCNE) and the Microsoft Certified Systems Engineer (MCSE). Today, the use of the term engineer is common in information technology positions where staff supports distributed computing networks.

While the CNE program was being developed, assessment was another challenge Novell had to solve. The NAEC and CNE program, although successful, eliminated the direct relationship between Novell and the student. However, when the course of study was completed, students took an official Novell certification test and a direct relationship was made between Novell and its certificants. Novell knew who they were and how to contact them (Shore, 2002, p. 2). Because of this, the testing process was of equal if not more importance than the actual education program itself.

To complement Rose's education efforts and to meet the formidable challenge of creating quality CNE assessments, E. Clarke Porter of Control Data Corporation (CDC) was recruited by Novell to develop the program's initial exams. Porter is a legendary computer-based assessment pioneer. At CDC, Porter developed the first commercial computerized testing technology, whose origins can be traced to university research projects. In 1960, the University of Illinois developed the world's first generalized



computer assisted instruction system called Programmed Logic for Automated Teaching Operations (PLATO). The system was built on the historic Illinois Automatic Computer (ILLIAC I). The computer, built in 1952 by the University of Illinois, is widely acknowledged as the first computer built and owned entirely by an American educational institution.

The PLATO system continued to be enhanced and by the mid-1960s, the hardware upon which it executed was replaced with CDC computers. William C. Norris (1911 - 2006), the pioneering CEO of CDC, was very interested in developing PLATO as a commercial product. He was convinced computer-based education would become a major market in the future. Concerned about the political unrest of the late 1960s, he felt much of it was due to social inequality. Norris believed PLATO offered a solution to inequality by providing higher education to segments of the population who would never be able to afford a traditional university education. In 1979, Norris stated CDC's mission was to "address the major unmet needs of society as profitable business opportunities" (Boschee, 2006, para. 8).

In 1971, Norris set up a new division within CDC to develop PLATO courseware and by 1974 PLATO was running on in-house computers at CDC's Minneapolis headquarters. In 1976 CDC purchased the commercial rights for PLATO. It was in this environment Porter began his pioneering work at CDC and where he developed the first computer-based testing to measure the instructional system provided by PLATO. By the early 1980s, CDC had developed a network of PLATO Testing and Certification Centers throughout the United States. Though the spirit of PLATO lives on through professional

certifications and other computer-based training and testing, it was a commercial failure, eventually costing CDC more than \$1 billion (Sullivan, 2006, p. B06).

Yet it was the work from PLATO that allowed Novell to meet its corporate vision of creating a global CNE program. The business logic was simple: Novell was a global company and therefore, certifications had to be designed to meet the needs of VAR employees and certification candidates around the world. When the CNE program was started, there were only 50 testing centers, and they were all located in the United States. Novell couldn't expect CNE candidates to fly to the United States to take its exams, although some did.

Through CDC's PLATO Testing and Certification Center's spin-off company, Drake Training and Technologies (today Prometric), Porter moved away from a CDC mainframe-based computer testing model to a distributed computing client/server-based architecture. The business model was also significantly changed to deploy proctored tests at thousands of sites around the world. To facilitate this paradigm change, Novell loaned money to Drake to build a global network of testing centers. These independent testing centers solved the problem of high-volume assessment administration for Novell so they could complete the requirements of a high-quality certification process without having to manage the day-to-day details.

While Porter built a global network of authorized testing centers for Novell, another man, Dr. David Foster, was hired by Novell in 1990 to improve the quality of the CNE computer-based tests. A recognized leader in computer-based testing and measurement, Foster created and improved computerized testing systems since 1982. As a psychologist and leading psychometrician, Foster used his knowledge of psychology

and statistics to create CNE exams so the job task analysis detailed the knowledge and skills to be measured, and test questions were clear and aligned to skill objectives (Shore, 2002, p. 5). In addition to this formidable accomplishment, Foster is also credited with introducing computerized adaptive testing (CAT), known as “direct performance measurement” at Novell, and pioneering simulation-based performance testing as part of the CNE certification program.

A simple example of the type of innovation Dr. Foster brought to the CNE exams was a testing design so a multiple choice question might have three answers of varying correctness and one incorrect answer instead of a traditional paper-based multiple choice exam that might have one correct answer and three incorrect answers. Dr. Foster designed CAT testing in 1991, with implementation by Drake/Prometric.

According to Foster, CAT “changed the perception of testing.” Since fewer questions are required, students and instructors were surprised a test that could be so brief could also be an effective measurement of one’s mastery over the subject matter.

Another testing innovation introduced in 1993 was the integration of technical resource material made available during the Novell examinations. At the time, CD-ROM drives were introduced at the Drake/Prometric testing centers to provide examinees access to reference resources. It was considered a major innovation, although the technology was very expensive at the time.

Shortly thereafter, Dr. Foster implemented computer simulations for both testing and training, another first in the industry. The simulations were in 1994 and the exams were modified to include 40 percent multiple choice and 60 percent simulations.

Other testing innovations at Novell included provisions for its worldwide appeal. Novell was the first information technology certification to translate its exams into multiple languages, leading the way to the global system that exists today. Examinees were presented with two screens, the examinees' native language and also in English. It was important to include both languages because some technical terms, such as "spooler," did not translate effectively into the examinee's native language. Therefore, examinees could view exam questions either in their native language or English. According to Dr. Foster, it was a "nice innovation that was simple, almost intuitive" (Foster D. D., 2011).

As Novell's testing methodology matured and expanded, so too did its certification offerings. In June 1989, shortly after the CNE certification was unveiled, a second, related certification was created, the Certified Novell Instructor (CNI). This professional certification was created so Novell could ensure students pursuing a CNE would have qualified instructors at its NAECs. By 1997, 5,000 individuals held the CNI certification.

The CNE program at Novell received a major boost in 1990 when Novell stratified its VAR program, segregating its resellers into platinum, gold, and standard categories. With the stratification, Novell required that VARs had to have CNEs on staff. Platinum VARs, for example, had to have two CNEs on staff at each location. VAR CNEs had special access to Novell support channels and were seen as important service/sales ambassadors from Novell directly to its business customers.

With the talent and resources behind Novell's CNE effort, it was a stellar success. Novell supported it by building CNE certification as its own educational branding. As a

result, customers and business partners were aware of CNEs and believed their skills could be trusted and CNEs were held in high esteem within the information technology industry. Because of these efforts, the value of a CNE and NetWare's market share continued to grow (Shore, 2002, p. 3).

By the mid-1990s, Novell's successful networking business and its certification program was bolstered by the exponential growth of the availability of the Internet and the new opportunities it brought to both training and testing. In 1994, Virtual University Enterprises (VUE) was founded by Porter, in conjunction with Steve Nordberg and Kirk Lundeen, to leverage the Internet to expand a global testing infrastructure. Like Drake before it, VUE was another company in which Novell invested to improve its certification model. VUE improved on the Drake business model by being one of the first commercial testing companies that successfully exploited the Internet and it developed a self-service test registration.

With the combination of its impressive training and testing program, Novell was incredibly successful with its certification program and many imitators soon followed. In 1992 Microsoft began its certification program and in 1993, the A+ certification program was started. The sheer volume of Novell's certificants was sure to inspire imitators. By 1999, ten years after Novell issued its first certification, over 150,000 individuals held the CNE certification.

Additional certifications soon followed the CNE and CNI certifications at Novell. A more advanced certification, the Enterprise Certified NetWare Engineer (ECNE), was introduced in February 1992. Novell's most advanced NetWare certification, its Master CNE, was initiated in 1995; by 1997, 7,000 individuals held the certification. Even more

popular than the CNE and ECNE certifications was its Certified NetWare Administrator (CNA) certification, started in September 1992; by 1997, over 180,000 people held the certification. A major milestone occurred at Novell in 1999, when it administered its 1,000,000 global exam aggregating its various certifications through its network of 1,450 NAECs and over 1,000 global testing centers.

In addition to Novell's innovations and success with its certification program, Novell was a leader in another educational aspect significant to this study. Novell was the first information technology certification program directly integrated into traditional secondary and postsecondary technology programs. In 1992, Novell started its Novell Education Academic Partner (NEAP) program. NEAP was Novell's (and the entire information technology industry) pioneer training program for integrating vendor-specific certifications with colleges, universities and trade schools. By 1998, more than 350 schools were NEAP partners, with a high percentage of community colleges.

One such college was Nassau Community College (NCC) in Garden City, New York. The NEAP integration with NCC, as a typical example, was detailed. NCC offered Novell authorized courses within its Computer Information System (CIS) curriculum. Its Network Management course (CMP 208) was equivalent to Novell's authorized courses IntraNetware: 4.11 Administration (520) and IntraNetware: 4.11 Advanced Administration (525). NCC's Server Configuration course (CMP 209) was equivalent to Novell's authorized courses 4.11 Installation and Configuration (804) and Building Intranets with IntraNetware (540).

The course books and materials used for NCC's CMP 208 and 209 courses were the same materials used at NAECs for the 520, 525, 804 and 540 courses. The CMP 208 and 209 courses were taught by a Certified Novell Instructor (CNI).

The CMP 208 and 209 are taught in a standard college format as a four credit hour course. The CNI was responsible for determining a NCC college grade for the student. The NCC course and materials prepared the student to take the Novell exams for the CNA certification and one exam towards the CNE certification (Kaplan, 2011).

Novell continued to strive for direct and indirect integration secondary and postsecondary college technology integration by pursuing ACE accreditation for its certifications and in 1999, receiving its ISO 9001 registration.

As noted by Dr. Adelman in his study *A Parallel Postsecondary Universe*, professional certifications are global in nature and perhaps much of the truth in that statement can be traced back to the pioneering work of Carolyn G. Rose.

Because of the global franchised nature of NAECs, Rose was often confronted with resistance to both the Novell-authorized courseware and testing. "I was often told, things are different in China, France, or Germany. Yet because our technology was the same throughout the globe, so too was the importance of having a standardized CNE or CNA," says Rose.

Rose's team, who was responsible for courseware and exams, ensured technical terminology that didn't translate well into other languages was removed. The results were so successful the precedent started by Novell has translated into millions of professional certifications, primarily on American products or from American professional organizations, held by certificants worldwide. Rose said:

One certification characteristic that was surprising was in India, where typically certificants augmented a four-year degree with Novell certifications. This was unlike the United States where certifications were often pursued by individuals who may have had technical experience, but no college degree and pursued a certification as a ticket for a new or more advanced job.

While I knew we strived to build a standardized global certification program, I didn't anticipate the extent to which we would change people's lives. I met CNEs and CNAs in India, in Europe, and the Middle East. Often, they were so full of emotion, they wept when I shook their hand. It was then I fully realized how our certification program was literally changing the world through Novell literacy (Rose, 2011).

**2.2.4.3 Current professional certification testing.** Because professional certification exams may be taken far away from the institutions that create the exams, many professional certification organizations use computer-based testing and/or use international-based testing centers. Among the three largest companies used in certification are Pearson, Prometric, and Certiport. The current and future state of computer-based assessments is significant because it influences technology education in general and professional certifications specifically.

A few but growing number of professional certification exams employ CAT which successively selects questions to maximize the precision of the exam based on what is known about the examinee from previous questions. The difficulty of the exam appears to tailor itself to the exam taker's level of ability. If an examinee performs well on a test question of intermediate difficulty, the examinee will then be presented with a more difficult question. Conversely, if the examinee answers a question incorrectly, the examinee would be presented with a simpler question. Consequently, CAT tests require fewer exam questions to arrive at accurate scores compared to traditional multiple-choice exams.



Other benefits of computer-based testing include diagnostic data for training continuous process improvement. By analyzing student test scores, professors can adjust their curriculum to focus on problem areas. Several testing programs, including Certiport, offer excellent reporting that allows professors to access aggregates reports of exam objectives and how students performed (Kelly, 2011, p. 10).

Pearson VUE is a part of Pearson PLC, an \$8 billion corporation that is the world's largest commercial testing company and education publisher. Primary Pearson VUE operations facilities are located in the United States, the United Kingdom, and India, with satellite operations in China and Japan.

Pearson VUE delivers millions of tests a year across the globe for clients in certification service markets. It has the world's leading test center network, with over 5,000 test centers in 165 countries, 230 of which are Pearson Professional Centers, owned and operated by Pearson. VUE was established in 1994; NCS acquired the company in 1997 and in 2000, NCS was purchased by Pearson PLC (Pearson VUE, 2009).

Certification organizations utilizing Pearson VUE include:

- Cisco
- CompTIA
- ISC2
- Linux Professional Institute
- Novell
- ITIL Foundation

Prometric is another leading technology-enabled testing and assessment service company. Headquartered in Baltimore, Maryland, other domestic offices are located in Lawrenceville, NJ, and St. Paul, MN, and international offices include Dublin, London, Manchester, Johannesburg, Gurgaon, Seoul, Tokyo, Beijing and Singapore. In total, Prometric has operations in more than 160 countries and 12 global offices.

Prometric offers test design, test delivery and data management services globally. In 2008, Prometric delivered more than nine million exams through a network of over 10,000 testing locations in more than 160 countries. In addition to its extensive global network of over 10,000 secure, proctored test centers, Prometric features anytime, anywhere, Internet-based test delivery (Prometric: Global and Growing, 2011).

Certification organizations utilizing Prometric include:

- CompTIA
- Linux Professional Institute
- Microsoft
- Novell
- Project Management Institute
- ITIL Foundation

A third significant testing company is Certiport, a company that specializes in in performance-based certification practice test and program management solutions for academic institutions and computer professional certifications.

Established in 1997, Certiport delivers nearly two million certification exams each year around the world. Certiport delivers certification exams through a specialized, worldwide network of testing centers or Certiport Authorized Testing Centers that serves one of three key markets: academic, corporate, or workforce development. Certiport delivers exams through an expansive network of over 10,000 partners in 150 countries worldwide (Certiport, 2011). Certification organizations utilizing Certiport include:

- Microsoft (Office Specialist and Technology Associate)
- CompTIA (Strata)

One other assessment company is significant to this study. Certification Subject Matter Experts (CSME) is an assessment organization that administers ITIL certification exams.

While computer-based testing technology has grown over the last two decades, there continues to be more to do. Dr. Foster, who played such a pivotal role in the initial creation of CAT, left Novell in 1997 to co-found Galton Technologies, a testing company which was acquired by Prometric/Thomson Learning in 2002. Dr. Foster also founded a security-based company, Caveon, in 2003. In approximately 2006, Dr. Foster founded Kryterion, a full service provider of customizable assessment and certification products and services. Kryterion builds skills tests and simple online assessments and to a comprehensive high-stakes worldwide certification program. Kryterion's specialty is integrating true online secured testing. Kryterion is used by many online colleges, including Western Governors University, already mentioned in this study.

Currently Dr. Foster is the chief scientist at Kryterion. Among the work still being worked on by Foster, it is to create enhanced security mechanisms so computer-based testing for certification exams may be administered at any location across the world, including examinee's homes (Foster D. D., 2011).

These sophisticated computer-based testing environments have allowed for a world-wide delivery of technology education that continues to impact secondary and postsecondary education.

**2.2.4.4 Professional certification trends and controversies.** As certification became the international standard for technical skills measurement later in the 1990s some vendors began to dilute their measurement programs in order to build volumes of certified individuals. Some vendors did not maintain the level of quality established by Novell. Technical certifications relatively easy to attain through only reading and classroom study gained the moniker of paper certification, implying the candidate had a

credential but could not actually do a job. Some programs tested only on what was covered in the product documentation, without regard to the complexities learned through experience. As a result, many certifications were no longer valued as a measure of job-related performance.

While clearly the inconsistency of certification quality diluted professional certifications' perceived value, it was not enough to stop their growth. Even so, the broad array of vendor-specific technology certifications has led some to question their worth. Critics point out that proprietary content distributed on the Internet allows students to gain credentials without the implied depth or breadth of experiential expertise. Certifying agencies have responded in various ways to these criticisms. Some now incorporate applied learning/hands-on elements, anti-cheating methodologies or have expanded their content. Other certification programs have been expanded so they take into account length of service or demonstrated experience (via industry peer and/or employer recommendation).

**2.2.4.5 Professional certification role with employers.** Employers of technology professionals can use certifications to ensure prospective employees possess necessary skills. Employers often desire and may even require certain computer certifications as a condition of employment (Speare, 2010). Employers may believe certified employees are better able to manage an organization's technology resources. For example, "many employers assume a certified network professional is better able to manage networked resources than is a non-certified counterpart" (Hunsinger & Smith, 2008).

A survey of hiring managers revealed they use certification to screen applicants, to differentiate between otherwise equally qualified applicants, to qualify for service-

agreement discounts and warranty protection, and to validate their employees' qualifications to their own customers, among other reasons. The usefulness of certification may depend on the technology subfield and the level of the position (entry vs. management). Hiring managers use certifications in addition to and sometimes in place of academic qualifications. Depending on the position sought, there are often clear advantages to possessing a relevant certification (Hunsinger & Smith, 2008, p. 249).

While few jobs today *require* professional technical certification, there are some that do. Most notably, the U.S. Department of Defense (DOD) Directive 8570.1 (also known as the Information Assurance Workforce Improvement Program), signed in August 2004, requires every full-time and part-time military service member, defense contractor, civilian and foreign employee with privileged access to a DOD system, regardless of job series or occupational specialty, to obtain a commercial certification credential accredited by the American National Standards Institute (ANSI), such as the Global Information Assurance Certificate. The Defense Department is one of the few employers in the United States demanding certifications as a condition of employment (Marsan, IT ethics: Survey shows increase in cert cheating, software piracy, 2011, pp. 1, 20-22).

As a result, there are concerns about the DOD's workforce. The workforce has experienced attrition of more than 13,000 in recent years. At the same time, the DOD projects its workforce demands will increase. It is believed by the DOD the number of U.S. graduates in critical areas is not meeting national, homeland and economic security needs. Science, engineering and language skills continue to have very high priority across governmental and industrial sectors. Many government positions, including the

DOD, require security clearances, thus limited only to U.S. citizens. Retirements also loom on the horizon and the DOD and other federal agencies face increased competition from domestic and global commercial interests for qualified job candidates (Committee on Science, Engineering, and Public Policy, 2007, p. 169).

Another example of a certification that may be required for a specific job is the Association for Operations Management's Certification in Production and Inventory Management (CPIM). Candidates for CPIM must pass a series of Association for Operations Management (APICS)-administered examinations on inventory, production planning, scheduling, and control to earn their certification. The CPIM distinction credits its holders with a level of knowledge in production and inventory management. Some job opportunities in production or inventory require a CPIM of all applications (Merle, 1999, p. 40).

As a final example, many companies (e.g., CompuCom and Ricoh) have made CompTIA's A+ Certification mandatory for their service technicians (Maguire, Freely, Clymer, Conway, & Schwartz, 2010, p. 38).

While federal and state government policy has long influenced educational trends, an important change in policy not only creates a requirement for a related professional certification for certain federal positions, but a new law has recently created a role for the government's funding of certification testing. On August 1, 2011, the federal government allowed reimbursement for more than one license or professional certification test (previously only one test was allowed) as part of the Post-9/11 Veterans Education Assistance Improvements Act of 2010 (Public Law 111-377) (U.S. Department of Veterans Affairs, 2011, Effective August 1, 2011 section, para. 5). The

Act passed the Senate by unanimous consent on December 13, 2010; passed the House of Representatives by a vote of 409-3 on December 16, 2010 and was signed by president Barack Obama on January 4, 2011.

In synthesizing this information it is apparent technology education has responded and evolved to meet the changing conditions of technology, society, and commerce. Although technology education adapts to these changing conditions, the need is greater now than ever before as technology continues to pervade society around the globe. Postsecondary education, professional certifications, and distance learning coupled to computer-based testing are all part of the contemporary technology education equation. This study's problem statement has been addressed in a limited way by several studies that measure the complex and dynamic problem aspects. Applicable studies and their contributions and impact to the present study are categorized by the three aspects of the problem statement have been analyzed and are discussed in the following sections.

### **2.3 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery**

The economy demands skilled technology workers, but there is currently a shortage of qualified applicants. Enrollment is down in many postsecondary college technology programs. Therefore, business and industry is offering a wide variety of incentives to earn credentials other than a traditional baccalaureate college degree, because these credentials/certifications can be earned in a shorter period of time because of its different learning format, thus easing the shortage of workers (Mason, 2003, p. 39). Therefore, several studies have been performed to evaluate various aspects of the decline in technology programs and what can be done to reverse the trend. The impact of two-year programs and certification education is also addressed.

Nationally, enrollment in postsecondary college technology programs have been in decline for over twenty years, but the decline has been more substantial since 2000. A study from 1993 predicted Industrial Technology programs would eventually disappear entirely (predicted in the study to be about 2005). The study examined enrollment trends of industrial arts/technology teacher education programs from 1970 to 1990 by analyzing data contained in the *Industrial Teacher Education Directory*. Information within these sources included the number of industrial arts/technology education graduates; graduates with other degrees such as vocational education, industrial technology, and construction management; and faculty characteristics.

The study examined enrollment trends in industrial arts/technology programs from 1970 to 1990 and identified several broad educational trends: (a) university programs and student enrollment continued to decline from the 1970 levels, (b) graduates with non-teaching degrees such as industrial technology have increased, and (c) universities with accompanying industrial technology programs have witnessed a significantly greater percentage decrease in technology education enrollment than those universities that do not. Industrial Technology program characteristics such as program strength, compatibility, viability, and attractiveness were addressed in the study.

The study concluded by asserting that if the 20-year enrollment trend from 1970 until 1990 continued, the demise of the educational programs would have occurred about 2005. It appears the findings and implications presented in the study served as a catalyst for further discussions on the health and direction of postsecondary industrial arts/technology programs since educational programs are continuing (Volk, 1993).



Along with these dire predictions, there continues to be an urgent need for technology graduates who understand at a high level how technology, manufacturing, and business intersect. Many organizations continue to favor technology professionals with a business background. Four-year college programs will likely remain relevant because the duration of the program allows for students to study both technology and non-technology courses, which produces so-called “well-rounded” employees (Fundaburk, 2005, p. 35).

Although the emergence of professional certifications has been called an educational “parallel universe” (Adelman, 2000), many educators believe a traditional four-year program is significantly different from professional certifications. Some educators place professional certifications into a category of workforce development training. According to some educators, in addition to an in-depth study of technology, college education develops students in “critical thinking, analysis, appreciation of the arts and diverse cultures, foreign languages, the scientific method, and the history and politics of their own and other societies” (Brookshire, 2000, p. 2).

Several studies have focused on the reasons why students select technology majors in four-year colleges. Most students select programs that academically interest them, but also increase their prospects for employment.

One study limited to computer technology programs suggests positive experiences in high school, interest in computing, an aptitude for math and physics, perceived job prestige, the expectation of a good salary, the encouragement from family members and the influence of a key individual such as a teacher or work supervisor, helped in the selection of a technology major. In this particular study, group interviews were utilized as the research method. Participants in the group interviews consisted of 54 traditional-

age undergraduate students in three Information Technology-related majors: computer science (CS), computer engineering (CE), and information technology and informatics (ITI) at a large public research university in the Northeast United States. Computer Science is a traditional major that includes multiple courses in programming, data structures, algorithms, computer architecture, and operating systems. The CE degree is linked to electrical engineering; consequently, the curriculum includes courses in systems and system engineering, signal processing, communication theory and networks, circuits, computer visualization, and computer architecture. The ITI degree is a hybrid or alternative program, including some programming courses (Java, XML, SQL) and other technology skills, such as database design, web design, networking, e-commerce, and information visualization along with human factors skills such as management, information policy and politics, social informatics, technology and learning, and knowledge management (McInerney, DiDonato, Giagnacova, & O'Donnell, 2006).

In a recent study that bridges the research areas of secondary technology program enrollment and certification integration, high school students were studied to determine their success factors when taking classes designed to prepare students to pass the exams required to become a Cisco Certified Network Associate (CCNA). The study is relevant to the present study because of the supposition that interests in secondary school lead to postsecondary college program selection. The study was performed to measure the factors that led to the effectiveness of the CCNA program. It was determined the most important factor associated with student technology achievement in high school is GPA. After this, four factors play a moderately important role: 1.) the student's motivation, 2.) the quality of instruction, 3.) the student's technology skills, and, to a lesser extent, 4.)

the student's gender. In that particular study the characteristics of the students, their school, and the instructional practices contributed to student achievement and confidence, as these factors influence the choice to enter associated college programs. U.S. high school students entering the first course in the CCNA program were studied using hierarchical linear modeling, a multilevel statistical technique. Twenty seven percent of eligible U.S. Cisco Academy secondary students participated (5,392 students at 764 high schools) (Dennis, Duffy, & Cakir, 2010, p. 139).

The Cisco Networking Academy has enrolled nearly four million students since its inception in 1997. In 2011, it reached a milestone by enrolling its one millionth concurrent student. The Cisco Networking Academy began with 64 schools and now has 10,000 academies in 165 countries. As of 2011, Cisco Networking Academy delivered one million online assessments monthly and 100 million online assessments (Jenkins-Blum, 2011, Key Networking Academy Statistics section).

Cisco partners with a broad range of education, government and nongovernment institutions of learning, offering courses in high schools, community colleges, universities and non-traditional settings. For high schools, the program is adapted to the needs of secondary students, and features hands-on, project-based training. The curriculum is aligned to the National Science Education Standards, The American Association for the Advancement of Science Project 2061 Benchmarks, and The Dartmouth Engineering Problem-Solving Methodology (Erie 1 BOCES, 2011). By partnering with high schools, Cisco has introduced the awareness of certifications and job prospects, thus hoping to increase enrollment in technology (in this case, information technology) in institutions of higher learning.

Within Erie County, Cisco has current Cisco Networking Academy partnerships with the following high schools: Sweet Home Central High School (Amherst), Kenmore High School (Kenmore), and Erie 1 BOCES (Harkness Career Center, Cheektowaga). The BOCES Harkness Career is atypical because it has approximately 1,100 students from 20 different area school districts enrolled in its 26 high-technology, state-of-the-art programs. In the past, Hutchinson Central Technical High School (Buffalo) and Riverside Institute of Technology (Buffalo) have also been Cisco Academies. Erie Community College is the only Cisco Networking Academy within Erie County that offers a postsecondary college degree integrated within its Associate's degree program (Cisco Systems, Inc., 2010, p. 6).

One final study referenced in this first aspect of the problem underscores the significance of gender. Many women have shied away from secondary and postsecondary college technology enrollment, and by extension, professional certifications. According to a 2004 study, some women declined to pursue technology education because they did not like the prospect of being one of the few females in the class or because of the concerns on some of the physical tasks related to some networking programs (for example, climbing a ladder to fix). Some women stated they had a concern male students dominated class discussions and projects and this behavior made classes less fulfilling for women students (Haimson & VanNoy, 2004, p. xv).

#### **2.4 Perceptions of student/employer value and awareness of professional certifications.**

The second aspect of the present study addresses student and employer perceptions of the value of certifications and asks whether colleges should make students aware of professional certifications. There are several studies that focus on this aspect,

although none has the comprehensive view of the scope of the technology programs this study addresses. Of the studies that exist, it is recommended colleges should make students aware of professional certifications. These studies also recommend methods in which educational institutions can become participate in the selection of which professional certifications may augment a four-year college degree.

There are several ways in which postsecondary colleges can make students aware of relevant professional certifications. At a minimum, studies suggest colleges should make students aware of the relevancy and availability of certifications, available study courses for preparation and examination sites. Mid-range involvement would involve all the previous activities plus administration of one or more of the available examinations for assessing student readiness for certifications. High end involvement could involve all the previous activities plus an exam center for the institution (Ray & McCoy, 2000, pp. 3-4).

One study identifies that a number of students indicate they lack knowledge about certification programs. Students believe faculty should play a more active role in informing them about certifications related to course content and the opportunities available to them through certification (Hunsinger & Smith, 2008, p. 261).

Another recent study emphasizes the importance of employer awareness of certifications and the significance placed on them. Public/Private Ventures, a national leader in creating and strengthening programs that improve lives in low-income communities, used an experimental research design to determine whether sector-focused certification programs raised the earnings of program participants, and whether participants were more likely to find employment, work more consistently, and obtain

higher-quality jobs. To answer these questions, 1,286 people were recruited for the study from across three selected programs over a two-year period. Baseline data were gathered from eligible applicants through a phone survey about their education and work histories, additional sources of income, living situations and experiences with other employment programs. Half of the participants were then selected at random to participate in the program (the treatment group); the remaining half (the control group) could not receive services from the study sites for the next 24 months, but they were free to attend other employment programs or seek access to other services. The three programs used in the study were the Jewish Vocational Service in Boston, Massachusetts; Per Scholas, in Bronx, New York; and Wisconsin Regional Training Partnership in (WRTP) in Milwaukee, Wisconsin.

WRTP is an association of employers and unions that seek to retain and attract high-wage jobs in Milwaukee and create career opportunities for low-income and unemployed community residents. WRTP develops training programs (generally lasting between two and eight weeks) in response to specific employers' requests or to clearly identified labor market needs. Its short term pre-employment training programs in the construction, manufacturing and healthcare sectors were included in the study.

Per Scholas was founded in 1995, driven by a concern about the rapidly growing digital divide. The organization's intention was to use technology to improve the lives of residents of the South Bronx, one of the poorest areas in the United States. Per Scholas was started by a business leader and a consortium of foundations with the mission of putting computer equipment and knowledge into the hands of disadvantaged students and families. Per Scholas refurbishes obsolete computers and then either sells them at a low

price to community residents or distributes them to disadvantaged people through partnerships with nonprofits, schools and community colleges. Per Scholas' computer technician training program was launched in 1998. Connected to a network of community-based organizations, the program was intended to provide disadvantaged people with the skills needed to compete for a growing number of local information technology jobs. The program was designed to prepare participants for jobs related to the maintenance of personal computers, printers and copiers, as well as computer networks.

Initially, Per Scholas did not focus on preparing participants to take the A+ certification exam, but as the organization worked with businesses, the importance of the certification became apparent. Per Scholas decided to use the A+ certification as a guide for curriculum development, a program consisting of 500 hours over a 15-week period. During the period of the study, the skills and knowledge tested in the A+ exam changed several times, and staff quickly instituted the appropriate changes to the curriculum. Per Scholas pays the fee (\$275 at the time of the study) for those who wish to take the exams after completing training.

To be admitted to Per Scholas, candidates must have either a GED or a high school diploma and successfully test at a tenth-grade level in both English and math, requirements that reflect both industry standards and the reading and math levels necessary to grasp the material included in Per Scholas coursework. As a result, 47 percent of Per Scholas' study participants had a high school diploma, 24 percent had a GED and 28 percent had some level of postsecondary education. Those with postsecondary education were further analyzed: 50 percent of foreign-born participants had some postsecondary education, compared with 22 percent of native-born participants.

The results of the study were dramatic. The median annual wage of the Per Scholas treatment group was \$19,343 and the highest subcategories included \$23,817 for foreign-born graduates and \$23,347 for formerly incarcerated graduates. Of the WRTP manufacturing-based sector, the annual median income for the treatment group was \$14,329.

Both Per Scholas and WRTP offered training that prepared participants to obtain industry-recognized certifications, a strategy that may have played a major role in participants' earnings gains. According to the study, further research is needed to understand how industry certifications affect earnings and wage gains and the role workforce organizations can play in helping disadvantaged workers and job seekers gain access to jobs once they have attained a certification (Maguire, Freely, Clymer, Conway, & Schwartz, 2010).

While the present study focuses on the value and awareness of postsecondary college technology programs and their intersection with professional certifications, there is overlap with certification integration in secondary schools. A notable study focusing on Career and Technical Education (CTE) was released in 2005 (Castellano, Stone III, & Stringfield, 2005). In that study, students from three representative high schools were evaluated that had CTE programs integrated with certification programs. The study found high schools that have integrated professional certification programs had trouble maintaining the instructional time necessary for students to qualify to take the exams required for certification. Surprisingly, even at those schools where certifications were integrated, students did not fully understand the value of them. The study found few students were aware of certification opportunities and even fewer were pursuing



professional certifications. However, there were also exceptions to this finding. Some students who took advantage of the opportunity to pursue certifications were advanced in their understanding of their career direction and how they perceived to achieve their goals.

At the secondary level, integration of professional certifications may offer something else of great value: introducing technology concepts that will inspire students to continue their education at a postsecondary educational institution. An earlier study from 2004 found one-third of the high schools who participated in the Cisco Networking Academy did not offer all the classes needed to prepare students for Cisco certification and the expectation was the certification would be achieved through a community college after graduation from high school (Haimson & VanNoy, 2004). However, Castellano's study suggests high school CTE programs integrated with professional certifications, even if not completed during the high school term, can keep students engaged in school.

#### **2.4.1 Value of certification compared to traditional four-year college degree.**

The relative impact that a professional technical certification has on a student's success depends largely on the educational level at which students obtain a certification. A student that has obtained a certification as an additional credential to a postsecondary college education has a strong theoretical foundation to build on, an increased marketability, and better chances for long term career success. The impact that a certification will have on a high school graduate's success is limited. As opposed to postsecondary college graduates, high school graduates lack a strong theoretical foundation and previous experience to draw from when faced with new technologies. Many entry-level certification programs offered in a formal education setting are meant

to prepare students for computer support roles or relates to services (Randall & Zirkle, 2005, p. 299).

While no study suggests professional certifications can replace a traditional four-year college degree, it does appear that in some cases, a job candidate with some college (less than a four-year degree) coupled with a professional certification may be as competitive as a job candidate with a traditional four-year degree. In *Redmond* magazine's 2011 (sixteenth annual) Information Technology Salary Survey, the average salary for respondents was \$84,608 while only 63.1 percent had a four-year degree or higher. Many of the survey respondents held at least one Microsoft certification. In the methodology used in this study, using proprietary survey software, Redmond e-mailed notices to 40,000 subscribers. The sample size was 1,475 (Domingo, 2011).

### **2.5 Relevancy and integration of professional certifications into secondary and postsecondary college technology programs**

Perhaps the most important aspect of this study is its third: the level of present and future integration of professional certifications into postsecondary college technology programs. There are presently many examples of integration between postsecondary colleges and certifications that are the basis of study. An example of such integration is the partnership between the American Society for Quality (ASQ) and Rochester Institute of Technology (RIT), a private non-profit technical college. ASQ certification holders can earn credits toward an RIT undergraduate program online (Cometa, 2009).

While several studies suggest a desire by students to integrate certifications as an added credential to two and four-year technology programs, there is also a growing acceptance of certification integration by academia, especially from educational institutions from outside the United States. In a 2006 journal article, professors from

Zyed University in Abu Dhabi said “Students are attracted to colleges that teach leading edge technologies and provide avenues to acquire certifications. . . It is important to include certification objectives into key courses in order to provide an opportunity for students to acquire certification upon completion of these courses” (Al-Rawi, Bouslama, & Lansari, 2006, p. 35).

Despite this one example, generally the role of professional certifications and how they relate to traditional secondary and postsecondary higher education continues to evolve. For example, in a new program sponsored by the American Society of Mechanical Engineers (ASME) for a Certified Engineer Manager, ASME contends an advanced engineering management degree is more desirable than an MBA to many organizations. An engineering manager has the education in engineering, science, management knowledge, and skills normally associated with an MBA. The certification program suggests not all engineers and other technical professional can pursue an advanced degree in engineering management. Passing the certification exam can get credit for those people too who have learned their management skills on the job (Tan, 2005, pp. 9-10).

While studies suggest that both employees and employers believe there is value to professional certifications, some express concerns about their value compared to the investment of time and costs. While one recently-completed study found a consistently positive view of the outcomes of postsecondary college students pursuing a technology professional certification, about one-third of the respondents rated their reactions to statements asking them whether they believe technology managers and hiring managers think they should pursue a technology certification as “neutral.”

The study discovered a gap between what technology and hiring managers desire from job applicants, and what students believe these managers look for in prospective employees. About one-third of respondents rated as neutral the statements asking them whether they believe technology managers and hiring managers think they should pursue technology certification (Hunsinger & Smith, 2008).

In Hunsinger's study, the research methodology used was to interview students. The researchers randomly selected fifteen CIS/MIS majors and asked each of them questions concerning their thoughts about Information Technology certification. Using structured interviews, the researchers investigated students' beliefs, thoughts, feelings, and attitudes about Information Technology certification. The researchers asked students to identify referent groups (such as parents, professors, or friends) who influence their decisions. In addition, students were asked about self-efficacy factors (such as lack of knowledge or money) that might prevent them from pursuing an Information Technology certification. Next, based on interview data, the researchers created an online survey using SurveyMonkey ([www.surveymonkey.com](http://www.surveymonkey.com)). The researchers then integrated the findings from the interviews with the theory of planned behavior constructs (Attitude, Subjective Norm, and Perceived Behavioral Control) to empirically analyze students' intentions to pursue an Information Technology certification. To verify the temporal stability of our survey instrument, the researchers conducted a pilot study. They asked students in two of our CIS/MIS courses to complete the questionnaire on two occasions approximately three weeks apart. Twenty-seven students completed the questionnaire on both occasions.

**2.5.1 The academic integration value of vendor-neutral compared to vendor-specific certifications.** There is also ongoing debate between the value of vendor-specific certifications compared to vendor-neutral certifications. The argument for vendor-neutral certifications and against vendor-specific certifications is since each organization sets standards for certification, they are inherently inconsistent (Barnhart, 1997, p. xviii).

Vendor-specific certifications, especially popular in the information technology field, evolved as a way to support products, increase market share, and build a knowledgeable sales force and are associated with branded technology from a particular company, such as Cisco and Microsoft.

Vendor-neutral certifications are offered by consortiums, nonprofit organizations, and industry associations. They revolve around key concept and job roles and do not focus on a particular vendor's product or technology (Randall & Zirkle, 2005, p. 288).

While there may not be specific studies focusing on the relative value of vendor-neutral versus vendor-specific certifications, there are many articles on the subject from experienced managers in the hiring field. One author recommends professionals should adopt vendor-neutral certifications (such as CompTIA's Network+ and A+), as default accreditations on resumes. In the information technology field, ISC2's Certified Information Systems Security Professional (CISSP) and PMI's Project Management Professional (PMP) certifications are also recommended because of their vendor-neutral status (Ekel, 2010, What's changed? section, para. 4).

Because of the relative objectivity of vendor-neutral certifications, it would be tempting to remove vendor-specific certifications from the present study entirely, except

they are of utmost importance in the area of secondary and postsecondary curricula integration. In addition, steps being taken to ensure vendor-specific professional certifications have independent accreditations. For example, in 2009, three Microsoft certifications (Microsoft Certified IT Professional: Enterprise Administrator, Microsoft Certified IT Professional: Server Administrator, and Microsoft Certified Systems Administrator: Security Specialization) have been accredited by the American National Standards Institute (ANSI), a first in the certification industry for a vendor-specific certification process (ANSI, 2009, Microsoft Corporation section). Several other Microsoft certifications are also in the process of being accredited by ANSI. Other vendor-neutral organizations have certifications accredited by ANSI including the Project Management Institute, CompTIA, Information Systems Audit and Control Association, International Information Systems Security Certification Consortium, Inc., and SysAdmin, Audit, Network, Security - Global Information Assurance Certification. ANSI has been the administrator and coordinator of the United States private sector voluntary standardization system for more than 90 years and is the primary organization in the U.S. to assess and promote the integrity of those standards.

In order to achieve a level of homogeneity and standards, some vendor-specific certification programs have formed the IT Certification Council, an independent council of industry leaders focused on Information Technology certifications committed to growing professional certifications, recognizing the need for a qualified workforce to support the world's technology needs. The council establishes industry best practices, markets the value of certification, exam security and other certification issues the Council

identifies. Vendor-specific member organizations include Cisco, Microsoft, and Novell (IT Certification Council, 2011, Members section).

### **2.5.2 Impact of the Carl D. Perkins Career and Technical Education**

#### **Improvement Act of 2006 and integration of professional certifications into**

#### **traditional secondary and postsecondary technology curricula.**

One of the most important developments on the integration of professional certifications occurred with the Carl D. Perkins Vocational and Technical Education Act of 2006 (Public Law 109-270). While the Act primarily impacts secondary technology education students, it is impactful to postsecondary education as well. The Act was first authorized by the federal government in 1984 and reauthorized in 1998. Named for Carl Dewey Perkins (1912 - 1984), a Democratic Congressman from Kentucky, the Act aims to increase the quality of technical education in the United States. Since its inception, the Act is considered to be successful and when renewed in 2006 it had enormous bi-partisan support. The renewed Act became law when signed by president George W. Bush on August 12, 2006.

The 2006 Act provides an increased focus on the academic achievement of secondary career and technical education students, strengthens the connections between secondary and postsecondary education, and improves state and local accountability. The Act uses the phrase “career and technical education” instead of the older “vocational education.” The Act also includes new requirements for “programs of study” that links academic and technical content across secondary and postsecondary education, and strengthens local accountability provisions to ensure continuous program improvement. The Act provides nearly \$1.3 billion in federal support for career and technical education

programs in all 50 States and extends through 2012 (U.S. Dept. of Education, Introduction section).

Two provisions of the Act have an impact on the integration of professional certifications. The first is “effective in-service and pre-service teacher and faculty education that assists career and technical education programs in . . . coordinating technical education with industry-recognized certification requirements.” The second, even more significant provision is states who apply for Perkins Act funding “shall establish and report to the eligible agency indicators of performance for each tech prep program for which the consortium receives a grant under this title. The indicators of performance shall include the following . . . the number and percent of secondary education tech prep students enrolled in the tech prep program who . . . complete a State or industry-recognized certification or licensure” (One Hundred Ninth Congress of the United States of America, 2006, p. 24).

Several states, including New York, have integrated professional certifications into their secondary career and technical education programs. One of the most innovative and aggressive state responses to the Perkins Act is in Florida.

In 2007, Florida passed the Career and Professional Education Act (CAPE) that ushered in a number of reforms for secondary career and technical education (CTE). CAPE required every Florida school district have at least one career and professional academy in operation no later than the 2008-2009 school year. More importantly, it required all career academy courses lead to industry certification or college credit linked directly to the career theme of the course. CAPE also required the Agency for Workforce Innovation and Workforce Florida, Inc., to identify appropriate industry certifications



based on the highest national standards available (Office of Program Policy Analysis & Government Accountability, 2008, pp. 2-3). In a report issued by Harvard University in 2011 noted that because of the program, over 20,000 young people have graduated with an industry-recognized certification (Harvard Graduate School of Education, 2011, p. 27).

The Perkins Act has also impacted postsecondary professional certification as well as secondary schools. In 2010 Northwestern Michigan College (NMC) (a community college that services more than 5,200 students) launched the Microsoft Technology Associate (MTA) program, integrated into its Computer Information Technology (CIT) program. NMC was a Microsoft IT Academy and one of the reasons why it was able to easily integrate into the program was because of the program being approved by the Perkins Act. Susan DeCamillis, NMC business academic chair said: “One of the Perkins indicators is third party assessment and we have made a commitment to provide our students with value-added credentials. We selected MTA as an assessment for CIT to meet state and federal grant requirements, but also to satisfy a strategic direction for the college to offer industry certifications and make our students more successful in the workplace” (Kelly, 2011, p. 10).

There are other aspects of the Perkins Act that can fund professional certifications including Tech-Prep, a federal program that provides assistance to states to award grants to secondary and postsecondary education institutions for the development and operation of programs consisting of the last two years of secondary education and at least two years of postsecondary education, designed to provide Tech-Prep education to the student leading to an Associate degree (U.S. Department of Education, 2009). Finally, the

School-to-Work Opportunities Act of 1994 (Public Law 103-239) can also be used as a funding source for certification programs (Haimson & VanNoy, 2004, p. 34).

**2.5.3 Relevancy and integration of professional certifications into postsecondary college curricula.** With the exception of for-profit colleges, relatively few of the traditional four-year technology programs incorporate professional technology certification training into their curriculum. For example, in 1999 several four-year institutions started offering certifications, although these were private for-profit colleges, such as the New York Institute of Technology (Fundaburk, 2005, p. 31).

There are many reasons why certifications remain rare in four-year educational institutions, even for vendor-neutral certifications. Absence of unbiased neutral groups for determining examination content, creating examinations, and sanctioning examiners may create some doubt about certification value. For vendor-specific certifications, there may be a lingering perception certifications merely tout commercial products. In addition, a rapidly changing knowledge base required for success in this field causes some to question the sustained value of certification. A more fundamental reason, however, is the continued perception that professional certifications fall into the realm of workforce development training and may not be consistent with the mission of a traditional four-year college which many view is to develop in students a wide variety of non-specific skills such as critical thinking, analysis, appreciation of the arts and diverse cultures, foreign languages, the scientific method, and the history and politics of their own and other societies.

A few studies have addressed this issue. According to one, educators may also be uncomfortable with the thought that certification examinations, rather than theory and

principles, drive the content of courses and academic programs (Ray & McCoy, 2000, p.

1). While this position may hold some validity, it is contrary to the basic principles of the century-old technology curricula.

There has also been research conducted on integrating certification programs into traditional four-year technology programs. Although much remains to be researched, the results of the researchers are third-party certifications, both vendor-specific and vendor-neutral, are part of the technology educational landscape.

Interest in certification by employers grows and there is a corresponding interest in certification among students and prospective students. According to one study, while a four-year baccalaureate education will remain the cornerstone of a college education, preparing students for success in the job market requires a three-pronged approach: education, certification and experience (Nelson, 2001, p. 286).

Another study concluded vendor-specific technology certifications are valuable and significant workforce development programs that should be widely offered by vocational and technical schools, community colleges, and commercial training companies (Brookshire, 2000, p. 2). There are many examples nationally of community colleges' integration with professional certifications. Adelman's *A Parallel Postsecondary Universe* influenced Northwestern Michigan College (NMC) to change its programs to integrate with professional certifications. Keith E. Kelly, a professor at NMC, said "ten years ago faculty and administrators in the Computer Information Technology program at NMC read a report from the U.S. Department of Education that discussed the importance of IT certification . . . When we heard about the emergence of

certification and how industry had defined objectives and assessments, we knew we needed to embrace this change” (Kelly, 2011, p. 10).

Within Buffalo, Erie Community College promotes their graduates of its Electrical Engineering Technology program are ready for the Certified Electronics Technician (CET) certification issued by the Electronics Technicians Association International and graduates that have completed the computer/electronics sequence are ready for the A+ Certification issued by the Computer Technology Industry Association (Erie Community College, 2008, p. 107). In addition, Erie Community College’s Information Technology with Networking Concentration degree offers the four courses necessary for a Cisco CCNA certification [TE 295 = Cisco I (Networking basics), TE 296 = Cisco II (Routers & Routing Basics), and TE 297 = Cisco III & IV (Switching & Routing, and WAN)] (Erie Community College, 2008, pp. 124-125). These programs, and others, are feeder programs into Buffalo State College’s technology programs, implying that Buffalo State College, does include classes that promote certification through its joint admission program with Erie Community College.

Some colleges, notably online colleges, offer baccalaureate degree technology programs designed as 2+2 enrollment. Southeast Missouri State University offers a Bachelor of Science in Technology Management that has as qualification for acceptance an accredited Associate of Applied Science degree in technically-oriented programs or students with a recognized national certification or exam score and three years of related work experience (Southeast Missouri State University, 2011, para. 2). Although Southeast does not currently have list of accepted Industrial Technology certifications, all nationally-recognized certifications are considered (Eller, 2011).

Another example is Excelsior College, which includes Information Technology certifications as a potential transfer into their four-year technology programs and awards credit for information technology certifications.

One of the most important certification integration achievements is the work performed by the Washington, D.C.-based nonprofit American Council on Education (ACE). Founded in 1918, ACE is the only higher education organization that represents all types of U.S. accredited, degree-granting institutions: community colleges and four-year institutions, private and public universities, and nonprofit and for-profit colleges. Together, ACE member institutions serve 80 percent of today's college students (American Council on Education, 2011, para. 1). ACE's College Credit Recommendation Service (CREDIT) connects workplace learning with colleges and universities by helping adults gain access to academic credit for formal courses and examinations taken outside traditional degree programs. Colleges and universities utilize ACE's course equivalency information to facilitate credit award decisions. Several organizations have had their certification programs evaluated by ACE for college credit to be considered by its member organizations (including Buffalo State College). Those certification organizations that have had their certification programs evaluated by ACE include Microsoft, Oracle, and the Institute of Industrial Engineers. Two for-profit distance learning companies (Learning Tree International and SkillSoft Corporation) who provide training for many of the certifications included in the scope of this study have had those classes evaluated by ACE for college credit recommendations (American Council on Education, 2011, para. 2). In addition, most SkillSoft courses are eligible for credit at the University of Phoenix (SkillSoft PLC, 2011, University of Phoenix section).

An additional study reinforces students' desire to integrate professional certifications into a technology program curriculum. The recent study published in 2010 focused an opinion survey of two year institutions and perceptions around integration of the technology program and A+ certification. Surveys were sent to students and instructors at two-year institutions. While the survey returns were relatively small (seven instructors and 71 students), a majority of the instructors (60 percent) and students (85 percent) expressed interest in obtaining an A+ certification as part of the computer program curriculum. The study concluded students desired integration between their college program and a certification program because of the perceived value it provided. The authors of the study said: "a high number of students were interested in becoming CompTIA A+ certified . . . [because they] felt that CompTIA A+ certification could improve the service and support offered to end users by CompTIA A+ certified IT professionals" (Olagunju & Zongo, 2010, p. 74).

Lastly, a study of a national technology assessment exam published in 2011 particularly resonates with the current study. Buffalo State technology professors Drs. Ilya Grinberg and Steve Macho, among others, presented the study of the 2010 initial production implementation of the Electrical Engineering Technology (EET) Nationally-Normed Assessment Exam at the American Society for Engineering Education's Annual Conference and Exposition held in Vancouver, British Columbia, Canada on June 26-26, 2011. Developed by the Institute of Electrical and Electronics Engineers (IEEE), Society of Mechanical Engineers (SME), and the Electrical and Computer Engineering Technology Department Heads Association (ECETDA), the purpose of the exam was to provide programs with an assessment tool used for educational institutions' ABET

reaccreditation. The exam also offers the opportunity for program continual improvement, leading to increased homogeneity of program curricula. The study measured student test participation from two EET programs: Buffalo State and Rochester Institute of Technology. The study, while not specifically measuring SME or other professional certifications, is nonetheless noteworthy and relevant. The study noted that “a nationally normed exam of this type was the first real experience for EET students with the test similar in format to professional certification exams that many of them will encounter in their careers. Students’ comments indicate that they were not psychologically ready for an exam of this type . . .” (Grinberg, et al., 2011, p. 6).

**2.5.4 Curriculum development and delivery.** Professional certification programs and related for-profit higher education institutions may compete with traditional private and public nonprofit higher education institutions in curriculum development and Internet-based distance learning delivery. Distance learning offers the potential of increased enrollments by giving access to a student population that could not otherwise attend courses offered. It also helps nontraditional students who often must juggle education with family and job responsibilities to stay in school (Clyburn & Johnson, 2001, p. 4).

However, distance education does not work for everyone. In one study, most respondents felt that without self-motivation the success in a distance education course would not be good. Respondents believed students who would be best suited for a distance education course are self-motivated. Yet, at the same time, it is believed those who benefit most from distance education are non-traditional students who had other

responsibilities in their life besides school such as work and family (Schmidt & Gallegos, 2001, p. 5).

## **2.6 Summary**

Extant literature on the subject of the present study is limited. The majority of the extant literature is in the form of journal articles. There are few current studies that measure the three aspects of the problem, although those that do exist will be summarized in the following sub-sections segregating the three aspects of the problem. Because the available research is limited and the need for the study is clear.

**2.6.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** Existing research shows a declining national trend in applied higher-education technology programs, especially industrial arts, industrial technology and computer information systems programs. The research shows outsourcing and negative perception of these fields contributes to the decline in enrollment, even as the need remains. It is unclear of the role of professional certifications, but it does appear as though it is an impact as it has been recommended certification programs should be used in lieu of traditional education programs to be competitive for employment as a result of the Recession of 2008 and technical fields with job shortages.

**2.6.2 Perceptions of student/employer value and awareness of professional certifications.** Research shows there is interest in learning more about professional certification programs through relevant college technology programs. Research also shows increased employer awareness and clarification is needed for professional



certifications, even while employers utilize the existence of professional certifications when making hiring and promotion decisions.

**2.6.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** There are research studies that show there is confusion about the role of professional certifications, even while there is acknowledgement of these certifications' value.

Whether professional certifications augment or replace traditional education is also unclear, even as some research suggests that, in some cases, professional certifications coupled with a two-year degree can replace traditional four-year formal college education. Policy makers at both the federal and state levels have focused primarily on access to higher education as a solution for individuals seeking higher employment objectives. However, failure to provide adequate support for college persistence and completion has left many individuals burdened with high student loan debt without acquiring a Bachelor's degree. In addition, many of today's growing occupations require skills more closely aligned to vocational credentials or an Associate's degree rather than a four-year college degree, resulting in a skills mismatch (Wilczynski, 2011, p. 9).

Research shows there is a desire by students to integrate relevant professional certifications into postsecondary college technology programs. Chapter Three will address the research methods used for the new research within the scope of this study.

### **Chapter Three: Methods**

#### **3.1 Introduction**

The purpose of this study was to associate Buffalo State College's technology programs within a scope to relevant professional certifications and to measure the perceptions on enrollment trends, certification value and awareness, and postsecondary certification integration from the perspective of program alumni, faculty, employers, and non-alumni and certification holders.

The research focused on three aspects related to the problem statement: Given the growth and recent federal emphasis on professional certifications, students of baccalaureate technology programs within the scope of this study need to understand whether professional certification credentials are important for employment after graduation; what is the impact of postsecondary college technology program enrollment trends; the value and need for awareness of professional certifications; and which professional certifications are relevant and academically integrated into their field of study.

Using Buffalo State College as a sample of a United States four-year technology degree-granting institution, this study addresses the problem statement by answering the following research question: What professional certifications are relevant to Buffalo State College's technology programs within the scope of this study; and should graduates of traditional technology programs have an expectation they will need to augment their education with these relevant professional certifications?

To gain insight to the research question, the researcher created a survey instrument, a questionnaire instrument, conducted interviews and assessed data pertaining

to enrollment statistics and other analysis of existing professional certification programs that relate to Buffalo State College's technology programs within the scope of this study.

The researcher acknowledges the assistance of the Offices of Institutional Research for Buffalo State College, Erie Community College, and Jamestown Community College for data accessibility. The researcher also wishes to express appreciation to all those who participated in interviews or surveys throughout the course of this study.

Within the three aspects of this study, the following detailed supporting questions were addressed by means of quantitative and qualitative research involving sample participants identified in this chapter.

### **3.1.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.**

*Supporting Research Question 1:* How do Western New York postsecondary educational institutions' technology program enrollments compare with national statistics?

*Supporting Research Question 2:* What factors influence students to pursue a technology-related education and vocation?

*Supporting Research Question 3:* What modifications can be made to recruitment methods to appeal to college students who may be candidates for technology programs?

*Supporting Research Question 4:* Is distance learning or on-demand Internet-based learning systems effective when compared to traditional technology curriculum delivery?

These questions are important to the overall research since they identify perceptions as to how enrollment can be increased and why enrollment may be dropping in technology programs.

### **3.1.2 Perceptions of student/employer value and awareness of professional certifications.**

*Supporting Research Question 5:* Should colleges make students aware of relevant professional certifications?

*Supporting Research Question 6:* What is the value of professional certifications to employers and students?

*Supporting Research Question 7:* Do professional certification programs replace or augment traditional education?

These questions establish whether Buffalo State College and similar degree-granting postsecondary educational institutions should make students aware of professional certifications associated with their technology programs. These questions also help to establish whether students should have an expectation whether certifications are important to augment a baccalaureate technology degree.

### **3.1.3 Relevancy and integration of professional certifications into postsecondary college technology programs.**

*Supporting Research Question 8:* What are the professional certifications relevant to the technology programs within the scope of this study?

*Supporting Research Question 9:* How are professional certification programs integrated into traditional technology college programs?

*Supporting Research Question 10:* Should certifications be integrated with associate or baccalaureate postsecondary degree programs?

These questions are core to the research study since they identify perceptions as whether students should pursue professional certifications as part of their academic objectives. In addition, the identification of certifications establishes a potential relevance of professional certifications to existing technology programs and indicates the level of integration into postsecondary programs within Buffalo State College and similar postsecondary institutions.

### **3.2 Setting**

For each of the aspects of the research problem, different methodologies were utilized in the research setting.

**3.2.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** The majority of the data for this aspect of the problem was obtained from Institutional Research departments of the identified degree-granting postsecondary institutions. Data were transmitted electronically.

**3.2.2 Perceptions of student/employer value and awareness of professional certifications.** This aspect of the research was obtained through two different settings: 1.) an electronic survey administered to BSC technology alumni; and 2.) interviews with business leaders and educators.

The quantitative research of the perceptions of professional certifications to BSC technology alumni was performed through the use of a researcher-made instrument administered electronically through the Internet.

Quantitative interview research was conducted primarily at sites throughout Western New York. The setting for data collection was made through field visits to area businesses and educational institutions, as well as other public and private meeting places. Where distance or scheduling obstacles were a barrier, telephone interviews were used, but these were performed on an exception-only basis.

**3.2.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** Quantitative research of professional certification organizations within the scope of this study was performed through the use of a researcher-made survey instrument administered electronically through the Internet.

### **3.3 Sample/Participants**

**3.3.1 Sampling plan used for study.** The nature of this study required a purposive sample for participants described in each aspect of the problem below.

***3.3.1.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.*** This aspect of the problem required two different purposive groups. The first was educational institutions with technology programs within Western New York. In addition to Buffalo State College, participants for enrollment analysis were selected from nearby community colleges that have technology program articulation agreements with Buffalo State College: Erie Community College, and Jamestown Community College. The full scope

of the programs is listed in Appendix Three. The criteria for including these schools is the colleges are all within 80 miles of Buffalo State College and these colleges have three or more technology programs that have dual admission/articulation agreements BSC's technology programs within the scope of this study (Buffalo State College, 2011).

Community colleges, in particular, are relevant to this study for two reasons. The first is when many of the technology programs were originally created at Buffalo State College, they were created as 2+2 programs; designed with the community college graduate in mind so students could continue to pursue their baccalaureate degree within their field of study. The second reason is historically, community colleges have more flexible program curricula and frequently incorporate professional certifications into their programs. Thus, even if Buffalo State College does not have a direct professional certification integration or accreditation feature, they indirectly may by accepting credits from an articulated community college which have previously integrated or accredited professional certifications.

For the second category, focused on perceptions of technology program enrollment, participants were the same as those detailed in 3.3.1.2.

***3.3.1.2 Perceptions of student/employer value and awareness of professional certifications.*** The researcher selected individuals who are considered representative because they meet the criteria for the study. The criteria includes alumni from one of Buffalo State College's six technology programs included within the scope of this study, those that are responsible for hiring people into jobs for which graduates of Buffalo State College's technology programs would qualify, relevant faculty members, and

certification holders and graduates of comparable programs from other institutions of higher learning. Specifically the following categories of individuals were sought:

- 1) BSC alumni of the six technology programs included in this study
- 2) BSC and other relevant institutions' technology faculty
- 3) Technology hiring managers and industry leaders
- 4) Professional certification holders and selected alumni of regional technical colleges

For the first category of alumni, sixteen responded from approximately 130 candidates invited to take the survey. The survey respondents were fairly representative of the six programs within the scope of this study: six graduated from BSC's Technology Education program; six from the Computer Information Systems program; three from the Mechanical Engineering program; and one was a graduate of the Industrial Technology program. For the second category, faculty members, qualitative interviews were conducted with nine faculty members. For the third category, leaders/managers of industry, six qualitative interviews were conducted. For the fourth category, certification holders and selected alumni of regional technical colleges, six qualitative interviews were conducted. In addition to these categories, three interviews which comprise original research augment the established literature review discussed in Chapter Two. A total of 24 interviews were performed within this study to answer the research questions within scope.

Each of the four categories of study participants were accessed through different channels. Buffalo State alumni were accessed by identifying alumni who received awards of the six technology areas within the scope of this study between the years 2000 and 2011 as published in commencement program booklets. Each of those individuals was then researched through the Buffalo State College alumni website. If an alumnus



had a published e-mail address, they were contacted that way. Not all alumni in the Buffalo State College alumni database have e-mail accessibility. For those who did not have access through the alumni association Internet website, the researcher determined whether the alumnus had a presence on the popular social networking Internet website Facebook. If so, they were contacted through that system.

The second category, faculty, outreach was made to faculty members of relevant programs, especially those integrated with professional certifications. The third category, leaders/managers of industry, outreach was made through professional networking contacts. The fourth category, professional certification holders/non-BSC alumni, was made through outreach to major certification organizations who publish directories.

***3.3.1.3 Professional certifications and their integration with postsecondary college technology programs.*** The researcher selected professional certifications organizations that met the scope of the study. A variety of sources including published studies, certification directories, trade publications, state and federal educational and labor sources, and other professional certification or membership-based professional organization Internet websites were used to identify professional certification organizations relevant to the six technology programs within the scope of this study. For Computer Information Systems, the number of professional certification organizations was further limited to professional certifications identified by leaders/managers of industry interviewed in the quantitative research portion of this study identified as being the relevant. Using these criteria, a total of 36 certification organizations were identified to be within scope.

**3.3.2 Description of participants.** Participants included in the scope of this study had no particular age, gender, race/ethnicity, language, disability socioeconomic status, but had in common a technology occupation (management or knowledge worker), technology education, or were part of an organization that provides professional certifications relevant to the scope of this study.

### **3.4 Scope**

The scope of this study included the measurement of the perception of technology enrollment/recruitment, professional certification value/awareness, and integration with postsecondary college technology programs.

- The independent variable, or cause, in this study is the existence of both technology curriculum programs and professional certifications.
- The dependent variable, or effect, is the perception of the effectiveness of the independent variable by the various groups of individuals surveyed.

The scope of this study also includes a comprehensive list of applicable certifications as defined within the scope of this study as detailed in Appendix Five. Also included in the scope of this study is an analysis of enrollment trends of the six programs included in this study.

### **3.5 Materials**

The materials used as part of the research included a survey, a questionnaire, structured interview questions, and recording equipment. Surveys were digital, created using the Internet-based Google Docs system. Google Docs is an Internet browser-based word processor, spreadsheet, presentation, form, and data storage service offered by Google, Inc. The system allows for the creation and editing of documents online while

collaborating concurrently with other users. The forms portion of Google Docs was used to construct the survey instrument.

Data gathered from the survey and questionnaire was entered into a Microsoft Excel 2010 database and analyzed using appropriate statistical techniques. Qualitative interviews were recorded using a digital voice recorder, if the subject permitted recording. If not, responses to the interview questions were recorded using pen and paper. If digitally recorded, the recordings were stored on media such as DVD as part of this study. Pen and paper notes have been saved as part of the documentation of the study and portions of interviews were electronically transcribed and quoted extensively in Chapter Four of this study.

### **3.6 Measurement Instruments**

The measurement instruments used to collect data in this study were researcher-made instruments.

**3.6.1 Perceptions of student/employer value and awareness of professional certifications.** Questions used for the survey are included in Appendix Two. The survey questions were then input into a Google Docs Internet-based survey form and responses were recorded in a Google Docs matrix.

**3.6.2 Relevancy and integration of professional certifications into postsecondary college technology programs.** Questions used for the questionnaire sent to professional certification organizations are listed in Appendix Six. Questionnaire questions were embedded into an e-mail and sent electronically to the professional certification organizations within the scope of this study. The results of these questionnaires, which primarily were sent through email, were augmented with data each

organization maintains through an Internet-based website. Responses were saved electronically.

### **3.7 Data Collection/Procedures**

Data collection was different for each area of the study and is detailed below.

**3.7.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** The data were collected by contacting directors of Institutional Research for each of the postsecondary schools identified that met the criteria through telephone and e-mail. Data were obtained electronically and sent via e-mail or was retrieved from Internet websites. Comparative data from U.S. Department of Education was retrieved from its official website.

**3.7.2 Perceptions of student/employer value and awareness of professional certifications.** The data were collected through surveys and interviews. The interviews were collected under natural, non-manipulative settings using researcher-made instruments. The data collection took place over a one-year timeframe. Each interview was tape-recorded for accuracy (if permission is granted by subject) or recorded using hand-written notes and, on average, lasted between 60-90 minutes in duration. Surveys were administered electronically through Google Docs. E-mail and Facebook systems were utilized as communication mediums.

**3.7.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** The data were collected by administering questionnaires electronically using e-mail and then compiling results into the Professional Certification matrix in Appendix Five.

**3.7.4 Industrial Arts education at Buffalo State College.** The primary research data presented in Chapter Four of this work is based on the evolution of Buffalo State College's technical program evolution from the late nineteenth century through the present. The researcher would like to acknowledge the information contained in Chapter Two, while in some cases extant research, is based on newly-available data whose accessibility would have been impossible even ten years ago. The data were collected by electronically searching arcane nineteenth century journals made available through the Internet service, Google Books. In 2004 by Google, Inc. contracted with several large academic and public libraries to scan their books into Google's databases, an initiative known as the Google Print Library Project (Pike, 2012, p. 1). Google's search engines had the ability to search the full text of books Google has scanned, converted to text (using optical character recognition technology), and stored in its digital database. In 2010 Google estimated about 130 million unique books exist in the world, and it intended to scan them all (Jackson, 2010, para. 1-2). By March 2012, Google announced it had scanned over 20 million books (Howard, 2012, p. A27). While Google Books had the potential to offer unprecedented access to the largest body of human knowledge in world history, its ambitious effort has been stymied by potential copyright violation lawsuits (Pike, 2012, p. 1). For the scope of this study, the researcher has searched data from late nineteenth and early twentieth century books and periodicals.

In addition to Google Books, other secondary sources, such as significant New York State newspapers, have recently become digitized searchable. Sources for these newspapers include Buffalo State College Butler Library subscription databases as well

as the unique Internet-based research site, [fultonhistory.com](http://fultonhistory.com), which had a searchable incomplete inventory of regional New York State newspapers.

### **3.8 Confidentiality of Data**

The researcher kept all data completely confidential. Although the names of subjects were known, when reporting on data, it had been kept confidential. Portions of qualitative interviews may be quoted within the scope of this thesis, but only with the subject's permission. Approval on data confidentiality and processes were approved by Buffalo State College's Institutional Research Board (IRB). All interviewees were given an IRB-approved Informed Consent form as part of this study. The approved Informed Consent form is included in Appendix Eight.

### **3.9 Data Analysis**

The data gathered from the study was analyzed using both qualitative and quantitative techniques. For quantitative analysis, the data were collected for national and regional technology program enrollment and graduation rates were converted to baseline percentages on a yearly-basis so the enrollment and graduation data could be compared to each program over time.

For qualitative interviews, the data collected was transcribed and categorized in terms of research questions and emergent themes. Specific interview questions were matched to answer the research questions. A coding method was used to organize interview data into a limited number of themes and issues around these questions. Quotations selected from the interviews will illuminate the themes and concepts.

Specific survey questions were also matched to specific research study questions. Data from the survey was compared with the data from the interviews to determine if they were in corroboration.

For surveys administered and for interviews that have components of the surveys they include either yes/no questions or Likert scale range (Likert, 1932). The results were analyzed using descriptive statistics. Statistical analysis was accomplished using standard statistical techniques. Chapter Four will present the research results within the scope of this study.

### **3.10 Summary Matrix of Methods Analysis**

The relationship between the aspects of the problem and its supporting research questions to participant categories, mode of data collection, data analysis, and method used to report results is summarized in Table 5.

Table 5. Matrix of Methods Analysis.

Problem Aspect	Supporting Research Question		Participant Categories	Mode of Data Collection	Mode of Data Analysis	Results Reported Method
College technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery	1	How do school and program enrollments compare?	BSC and community colleges with articulation agreements	Enrollment data from Offices of Institutional Research	Quantitative	Graphs and table
	2	What influences student choice of technology program?	Technology alumni and faculty	Survey and interviews	Qualitative	Narrative excerpts
	3	How can recruitment methods be improved?	Technology alumni and faculty	Survey and interviews	Qualitative	Narrative excerpts
	4	Are online classes as effective as traditional classes?	Technology alumni and faculty	Survey and interviews	Qualitative	Narrative excerpts
Perceptions of student/employer value and awareness of professional certifications	5	Should colleges make students aware of certifications?	Technology alumni and faculty	Survey and interviews	Qualitative and quantitative	Narrative excerpts
	6	What are certifications value to students and employers?	Technology alumni, faculty, hiring managers, and industry leaders	Survey and interviews	Qualitative	Narrative excerpts
	7	Do certifications replace or augment college degrees?	Technology alumni, faculty, hiring managers, and industry leaders	Survey and interviews	Qualitative and quantitative	Narrative excerpts
Relevancy and integration of professional certifications into postsecondary college technology programs	8	What certifications are relevant to scope of study?	Relevant certification organizations	Questionnaire	Qualitative and quantitative	Chart, table and narrative excerpts
	9	How are relevant certifications integrated with technology programs?	Relevant certification organizations and technology faculty	Questionnaire and interviews	Qualitative and quantitative	Chart, table and narrative excerpts
	10	Should certifications be integrated with technology programs?	Technology alumni and faculty	Survey and interviews	Qualitative and quantitative	Narrative excerpts



## **Chapter Four: Results**

### **4.1 Introduction**

Chapter One of this study contains an introduction to the problem through the following statement: students of baccalaureate technology programs within the scope of this study need to understand whether professional certification credentials are important for employment after graduation; what is the impact of postsecondary college technology program enrollment trends; the value and need for awareness of professional certifications; and which professional certifications are relevant and academically integrated into their field of study.

This study addresses the problem statement by answering the following research questions: What professional certifications are relevant to Buffalo State College's technology programs within the scope of this study; and to what degree will graduates of technology programs be expected to augment their education with these relevant professional certifications?

The research contained in this study focuses on three aspects related to the problem statement. The three aspects related to the problem statement and research question are:

1. Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.
2. Perceptions of student/employer value and awareness of professional certifications.
3. Relevancy and integration of professional certifications into postsecondary college technology programs.

The following Buffalo State College programs are included within the scope of the study:

1. Computer Information Systems, B.S.
2. Electrical Engineering Technology: Electronics, B.S.
3. Electrical Engineering Technology: Smart Grid, B.S.
4. Industrial Technology, B.S.
5. Mechanical Engineering Technology, B.S.
6. Technology Education, B.S.

Chapter Two contains a review of existing literature associated with the problem. In addition, Chapter Two technology education milestones are described in a chronology on both a national level as well as within Buffalo State College, including the impact of federal legislation targeted to promote technology education. This chronology, shown in Table 1 explores the basis of both the six technology programs within the scope of this study as well as the origin of professional certifications.

Chapter Three discusses the methods used to research the problem. Different methods were followed for each of the three aspects of the problem. For Aspect 1 (enrollment), the primary method to collect data were to obtain enrollment and graduation quantities for the six areas of the study from Buffalo State College and community colleges with dual/admission articulation agreements within the criteria of this study. Enrollment data were augmented by qualitative interviews and survey results from BSC alumni. For Aspect 2 (perceptions of student/employer value and awareness), two data collection methods were used. One data collection method used was interviews with business leaders and technology faculty. Another data collection method used was through a survey to Buffalo State College alumni of technology programs and non-BSC alumni certification holders. Over 100 surveys were sent out to these groups and the

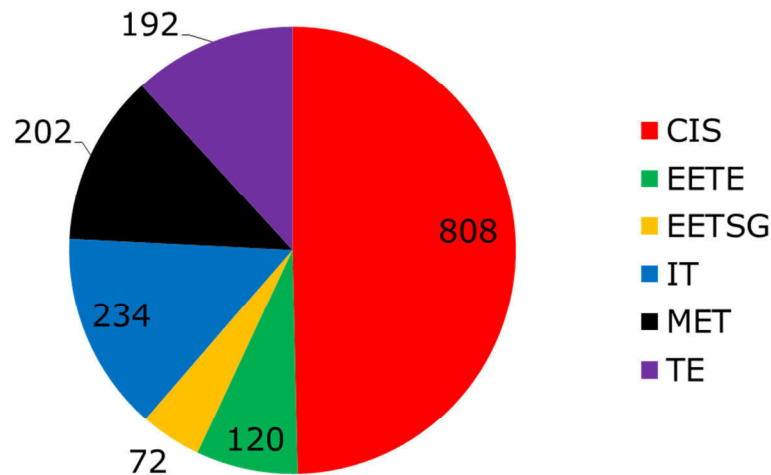
sample size was sixteen. Several interviews were also conducted with BSC alumni to augment and verify the data collected from the survey instrument. For the Aspect 3 (integration of professional certifications), the primary method to collect data were from professional certification and accreditation organizations through a survey.

Chapter Four presents the results of the data collected.

#### **4.2 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery**

While this study is focused on professional certifications and their growth, their impact is linked to enrollment trends of degree-granting postsecondary technology programs, specifically the six programs within the scope of this study. To analyze enrollment trends, the researcher has compiled enrollment and graduation data from Buffalo State College, as well as several two-year community colleges with which Buffalo State College has dual admission/articulation agreements for the technology programs within the scope of this study.

Data were compiled from Buffalo State College's Office of Institutional Research and includes baccalaureate graduates rates from 2000 to 2011. Of the programs within the scope of the study, the total number of graduates during 2000-2011 was 1,628. Computer Information Systems (CIS) made up nearly half the graduates at 808. The remainder, 820, was fairly equally distributed with 192 graduates within the Electrical Engineering Technologies departments: 120 in Electronics (EETE) and 72 in Smart Grid (EETSG). Industrial Technology (IT) had 234 graduates; Mechanical Engineering Technology (MET) had 202 graduates; and Technology Education (TE) had 192 graduates. A pie chart showing the portions of the total is depicted in Figure 26.



**Figure 26. 2000-2011 Total BSC graduates from six technology areas within scope of study.**

Enrollment trends were also analyzed. Of the six programs within the scope of this study, comparing inclusive full and part-time student enrollment data over the period from 2000 until 2011, only two programs had notable increases. Mechanical Engineering Technology enjoyed reasonable growth during 2007-2011. Within the period of analysis, the year with the lowest enrollment was 2004 with 80; the years with the highest enrollment was in 2010 and 2011, when enrollment in the program was 142 students. The other program that experienced growth, although modestly, was Electrical Engineering Technology-Electronics. Within the past decade, the year of lowest enrollment was 2004 with 52; by 2010, enrollment increased to 74; in 2011 enrollment dropped just slightly with 73 students enrolled. Electrical Engineering Technology-Smart Grid's (EETSG) enrollment was relatively flat during the decade. In 2000 and 2010 EETSG enrollment was both 43, however during the decade, enrollment dropped; in 2007 its enrollment was 29. EETSG's enrollment rebounded and in 2011 enrollment was at 47. Technology Education also experienced a modest decline during the decade; in 2000 enrollment was 66, by 2011 enrollment had decreased to 46 students, although the

program did experience growth spikes during the period of analysis: in 2003 and 2004 enrollment was 92. Two of the six programs within the scope of this study experienced measurable declines in enrollment during the first decade of the twenty-first century: Industrial Technology (IT) and Computer Information Systems (CIS). In 2000, the Industrial Technology program enrollment was 128; during 2006-2010, enrollment ranged between 55-59 students. However, enrollment rebounded slightly in 2011 with enrollment of 69 students, although still just more than half of the amount of student enrollment compared to 2000. The drop is even more significant when compared to 1989 when IT program enrollment was at 287 students.

Computer Information Systems has seen nearly as dramatic a decline in enrollment as Industrial Technology. During the period of 2000-2010, enrollment peaked in 2001 at 395 students; by 2011, it had dropped to 211 students. While the drop is dramatic, there is some good news. The last year with a significant drop in enrollment was the year between 2007 and 2008. In 2007, enrollment in the CIS program was 238; in 2008 it was 216. In the four years between 2008 and 2011, enrollment has only fluctuated slightly, between a high of 216 and a low of 210 students in 2009. This indicates enrollment has bottomed out and has stabilized. There may even be opportunities for modest growth if BSC parallels national trends. The most recent Computing Research Association's (CRA) annual Taulbee Survey (2009-2010) queried 265 Ph.D.-granting departments and received 195 responses. While the Taulbee survey covers only Ph.D.-granting programs, based on CRA's experience, the trend matches the overall CS graduation results reported by the National Science Foundation and the National Center for Education Statistics (Bizot, 2012). According to the survey, total

enrollment in Computer Science Bachelor degree programs increased ten percent, the third year of increases (Zweben, 2011, p. 4). While both BSC and national enrollment in computer programs appears to have stabilized, there is room for significant growth compared with enrollment at the beginning of the decade.

A chart of enrollment of all the technology programs within the scope of this study, with the exception of CIS, is shown in Figure 27. Because of the scale of enrollment in CIS being greater than the total of other five programs within the scope this study, a chart showing BSC enrollment data during the first decade of the twenty-first century as well as the average enrollment in computer science majors from the CRA Taulbee survey is included in Figure 28.

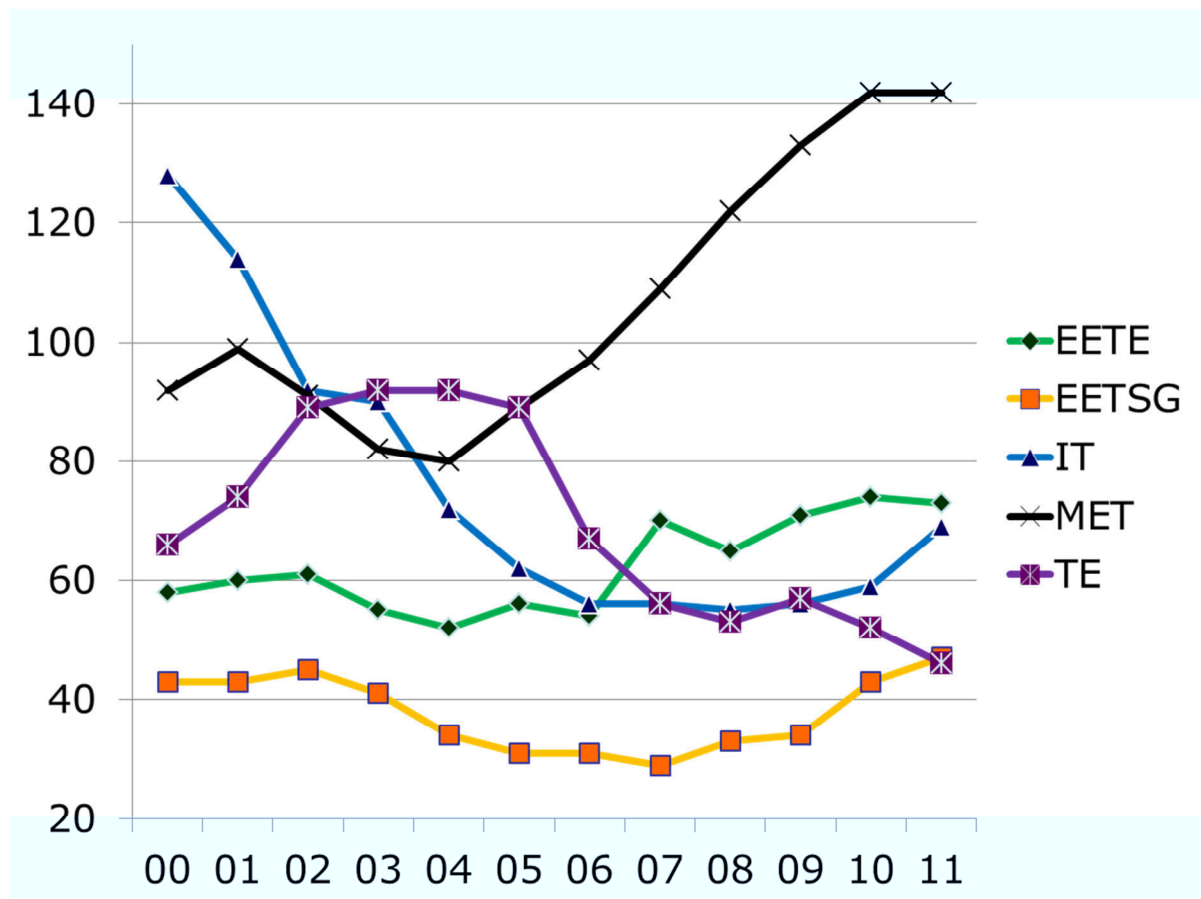


Figure 27. 2000-2011 BSC Enrollment in five technology programs.

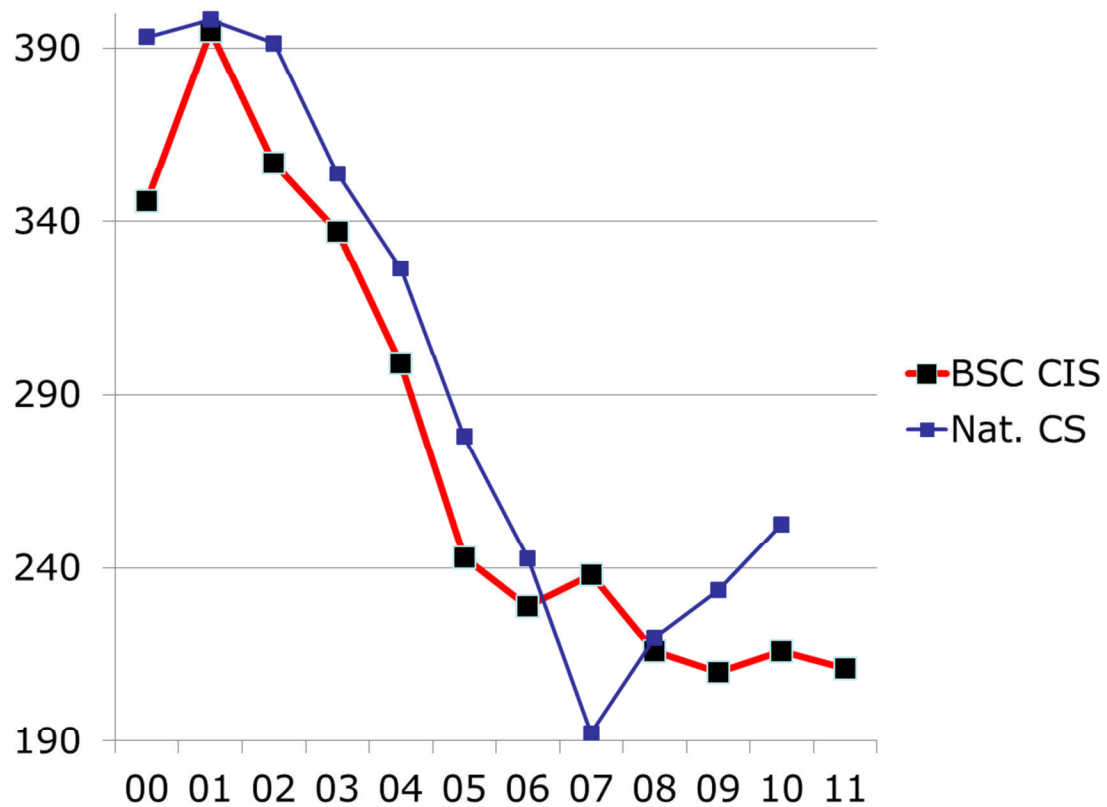


Figure 28. 2000-2011 Enrollment for BSC Computer Information Systems compared to National CRA Taulbee Survey of BS Computer Science programs.

Because of the extreme difference in scale, Figure 29 shows all six programs enrollment, comparing each year as a percentage of baseline enrollment at 2000. Of the three programs with significant changes in enrollment during the decade between 2000-2011, Mechanical Engineering's enrollment was up 54 percent in 2011 compared to its enrollment in 2000. In 2011, Industrial Technology's enrollment was 54 percent of what it was in 2000 (down 46 percent). In 2011, Computer Information Systems' enrollment was 53 percent of what it was in 2001 (down 47 percent).

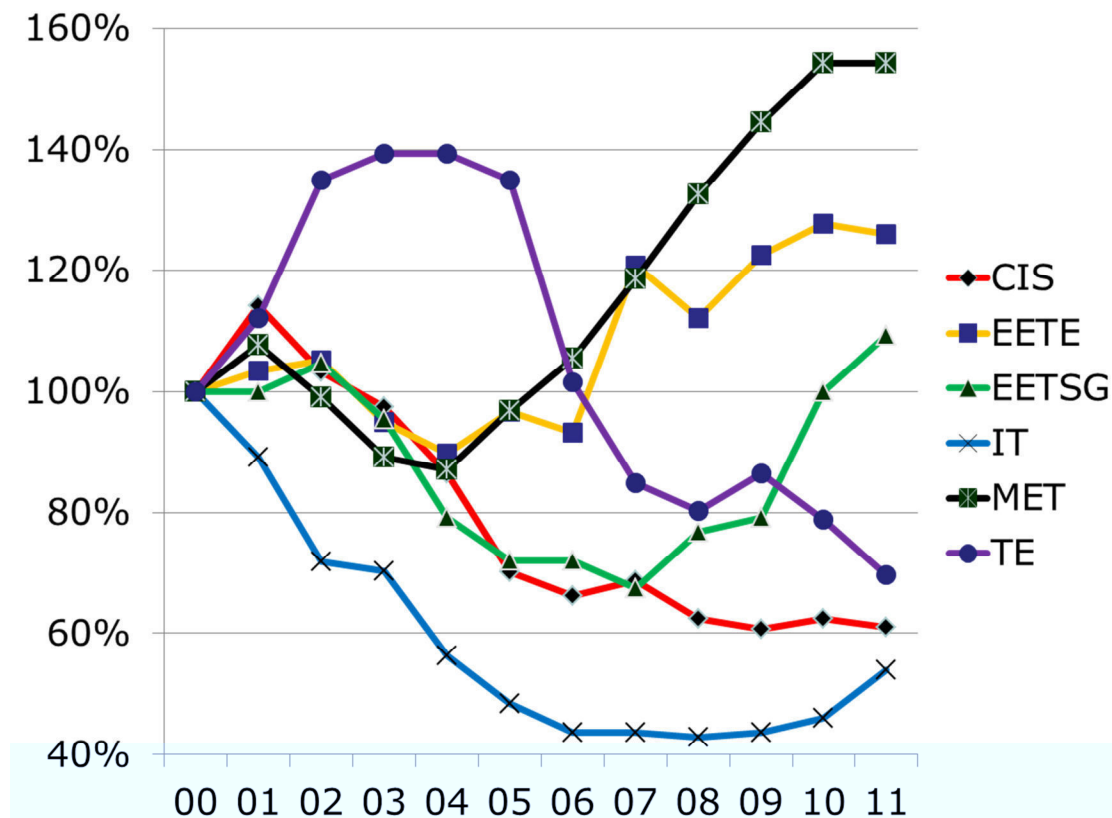


Figure 29. 2000-2011 BSC Enrollment percentage of baseline for six programs within scope of study.

When comparing program enrollment trends between Buffalo State College and national trends, baccalaureate graduation rates were used between 2000-2008, the most recent data available from the U.S. Department of Education. The same baseline percentage model used in Figure 29 is also used in Figure 30. National graduation data are aggregated for all engineering and engineering technology graduates. In order to present like information, the graduation rates of the three engineering programs within the scope of this study: EETE, EETSG, and MET were included. In 2008, national engineering graduates were nearly 117 percent compared to 2000 graduates. National engineering technologies graduates had a very modest increase: 2008 national engineering technologies graduates were nearly 104 percent compared to 2000 graduates.



When comparing this national data to BSC graduates during the same period, graduation rates varied greatly during the time period 2000-2008, however there was a marked decrease in graduation rates, as 2008 graduates were only 54 percent of what they were in 2000 (down 46 percent). However, since 2008, graduation rates have rebounded; in 2011, graduation rates were nearly 114% compared with 2000.

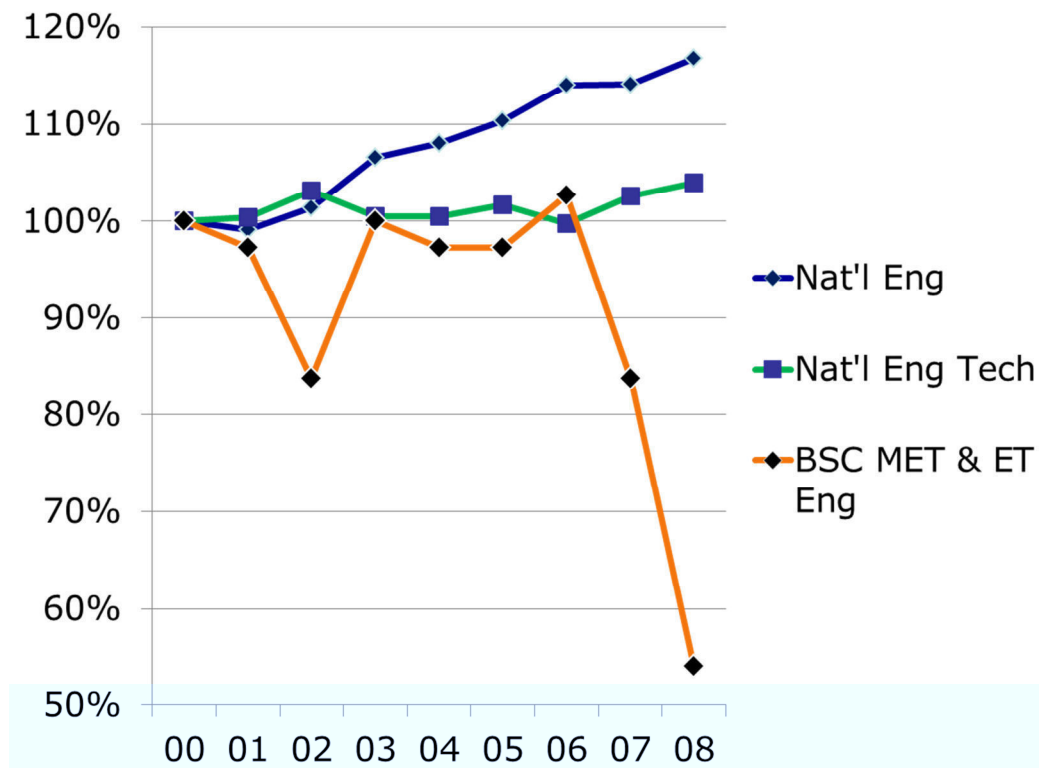


Figure 30. 2000-2008 Comparison of baseline percentages of BSC engineering and national engineering four-year graduates.

The same procedure was also used to compare Computer Information Systems graduation rates between Buffalo State College and national trends. In 2008, national computer-related graduates were 102 percent compared to 2000 graduates, a modest increase. However, that does not reveal the whole story. Within the period of the study, enrollment rose during the first half of period, peaking in 2004 at 154 percent compared to 2000. Buffalo State's CIS graduation rates nearly paralleled national trends with a rise

during the first few years, also peaking in 2004 with nearly 143 percent compared to 2000. The period ended with 2008 being 82 percent of 2000 graduates (down 18 percent). However, when 2008 national graduates are compared with 2004, graduation rates dropped 35 percent, from 59,488 to 38,476. This information is presented in Figure 31.

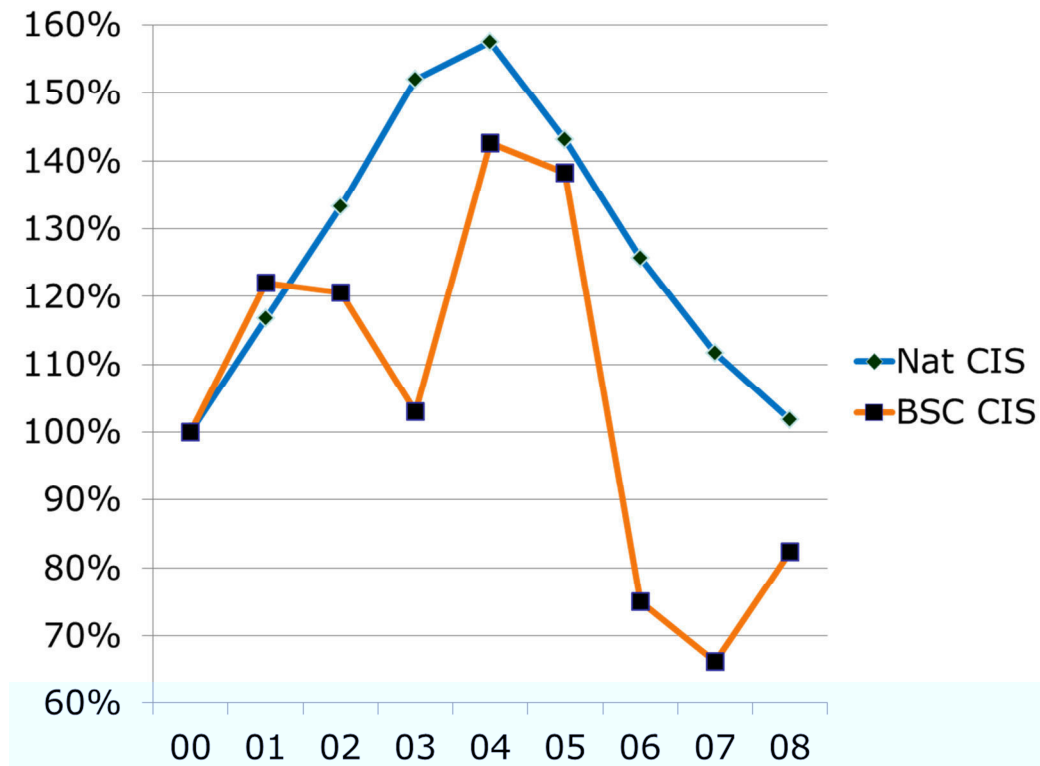


Figure 31. 2000-2008 Percentage of national and BSC computer-related graduation compared against baseline.

In order to ensure the analysis of Buffalo State College enrollment and graduation rates are consistent not only with national trends, but also regional educational institutions, data were also analyzed from regional two-year community colleges with which Buffalo State College has technology articulation agreements. Indeed, several of Buffalo State's technology programs within this study's scope were originally designed

to be 2+2 programs, to accept graduates from articulated community/junior colleges in order that students would be able to graduate with a baccalaureate degree.

One such college is Jamestown Community College, located approximately 80 miles southwest of Buffalo. A slightly different model was used to present the data available, enrollment during the period between 2003-2010. College-wide, enrollment increased significantly during the period data were available. In 2003, college enrollment was 3,598 and in 2010, it was 4,182, although enrollment dipped a bit in 2011 to 4,126 (Rey, Community colleges' enrollments decline , 2011, p. A1). In order to obtain an accurate trend in program enrollment compared to Jamestown Community College total enrollment, articulated agreement programs were compared to total enrollment for the year. Five programs are included: Computer Information Systems (CIS), Computer Science (CS), Information Technology (InfoTech), Engineering Science (ES) and Mechanical Technology (MT). Declines are observed in all program areas and are shown in Figure 32.

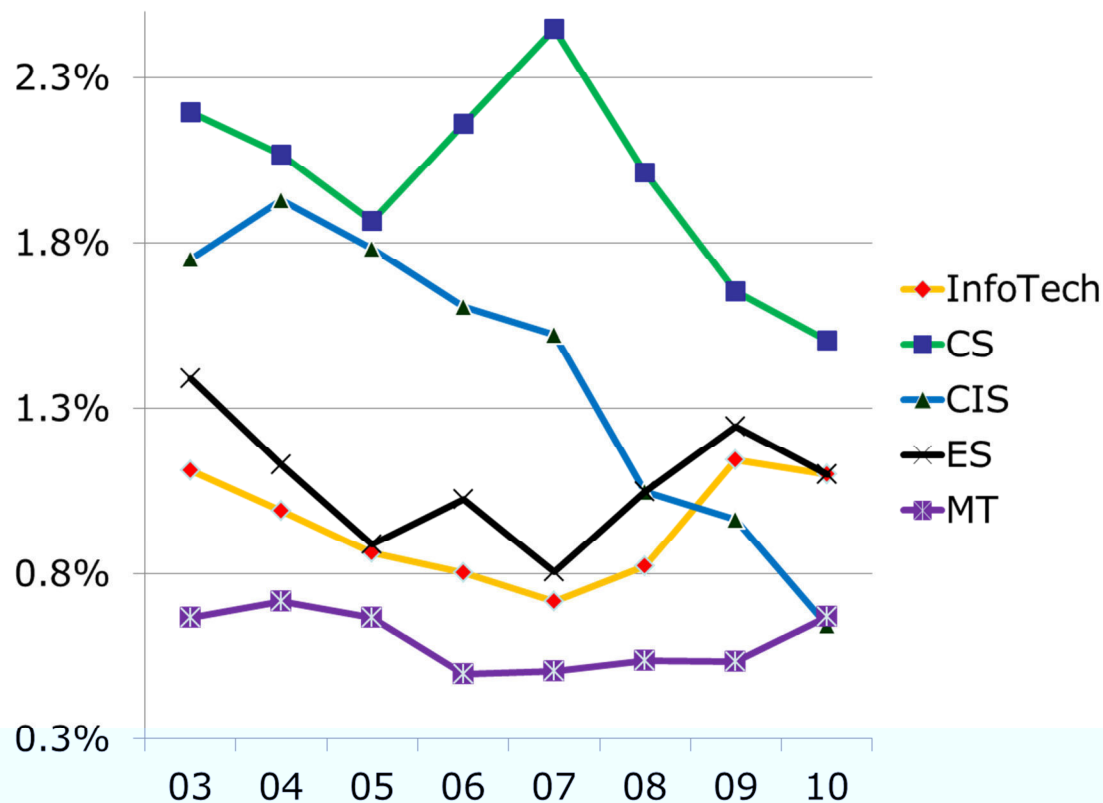


Figure 32. 2003-2010 Jamestown Community College articulation programs with BSC programs within study. Percentage of enrollment compared to total enrollment.

Another community college with BSC articulation agreement is Erie Community College. Significantly larger than Jamestown, Erie Community College is New York State's first multi-campus public community college outside of New York City. ECC is Western New York's second largest college (Erie Community College, 2009). At its three campuses (Buffalo, Williamsville, and Orchard Park), it offers the following degree programs: Associate in Arts (A.A.), Associate in Science (A.S.), Associate in Applied Science (A.A.S), and Associate in Occupational Studies (A.O.S) (Erie Community College, 2008, p. 5).

Erie Community College was founded on April 4, 1946 as the New York State Institute of Applied Arts and Sciences at Buffalo as one of five, two-year technical institutes created by the State of New York Legislature. When SUNY was created in

1948, the Institute at Buffalo became one of its colleges. Erie County assumed sponsorship of the college, and its name was changed to Erie County Technical Institute. In 1969 the college's name was changed to Erie Community College (Erie Community College, 2008, p. 6).

In autumn 2011, enrollment at its three campuses was approximately 14,300 students, both full and part time (Rey, Community colleges' enrollments decline , 2011, p. A1). Enrollment and graduation data were analyzed for those programs that have articulation agreements with the BSC programs in the scope of this study, detailed in Appendix Three. Overall, the graduation and enrollment rates were similar to the associated programs at Buffalo State College. While there was fluctuation in the graduation rates of three engineering programs at Erie Community College (Electrical Engineering, Civil Engineering, and Mechanical Engineering) during the decade of 2000 – 2010/2011, generally the rates were flat. Electrical Engineering averaged 8.5 graduates during the decade; Civil Engineering averaged 8.2 during the decade; and Mechanical Engineering averaged 6.5 graduates over the decade. Graduation rates of the three engineering programs during the decade of 2000-2011 are shown in Figure 33.

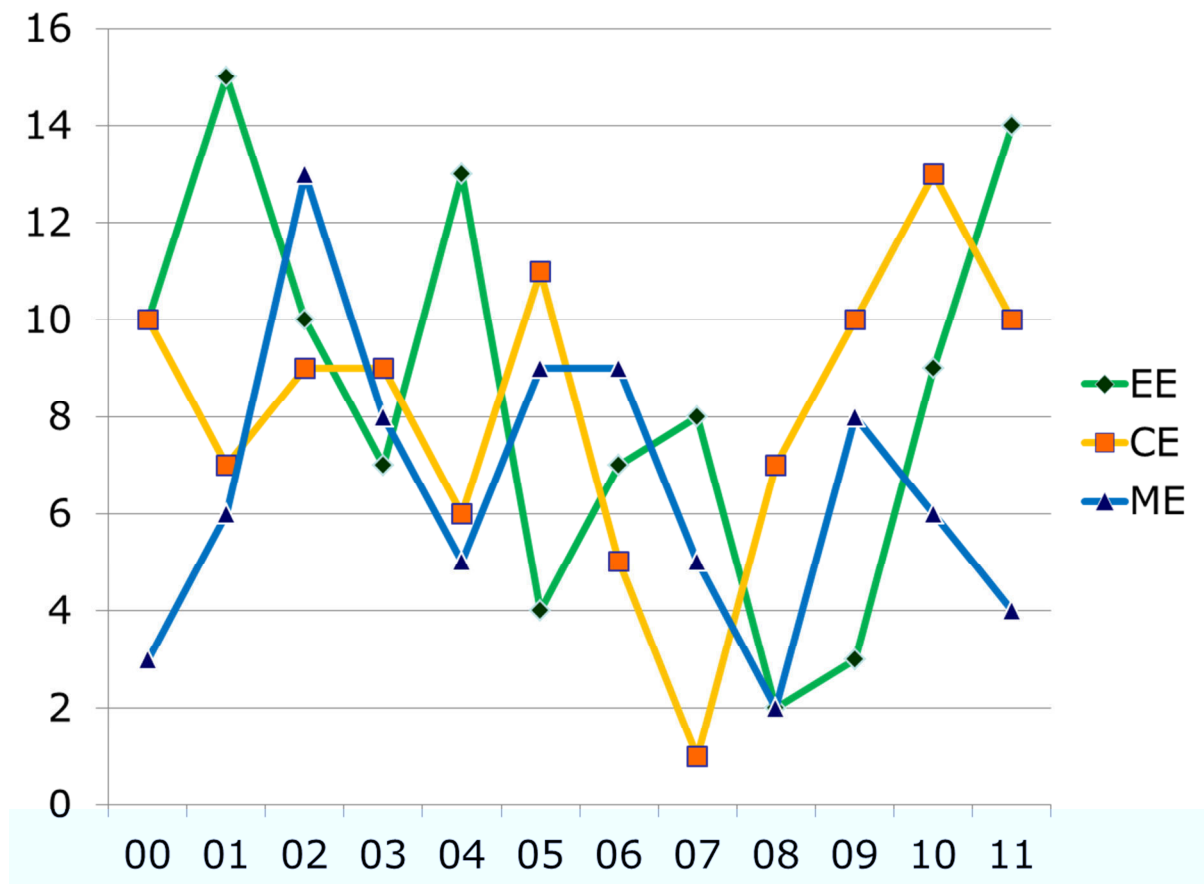
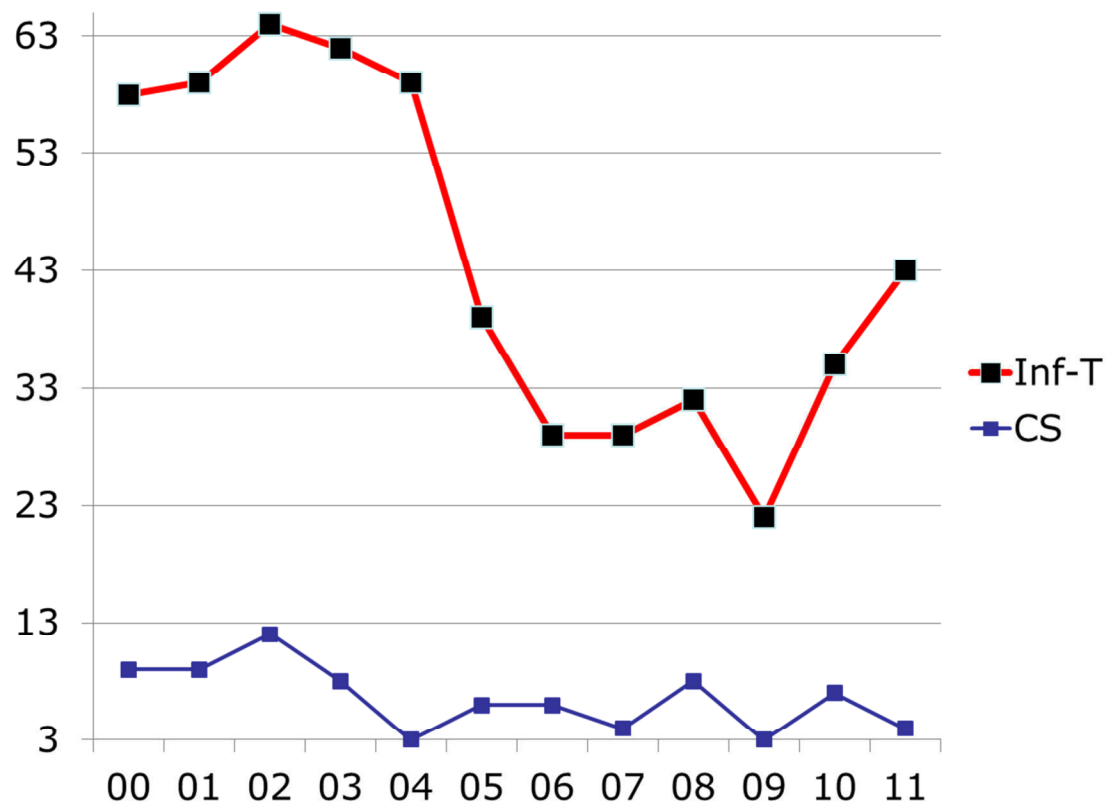


Figure 33. Graduation rates for ECC's three engineering programs (Electrical (EE), Civil (CE), and Mechanical (ME)) were relatively flat during the decade of 2000-2011

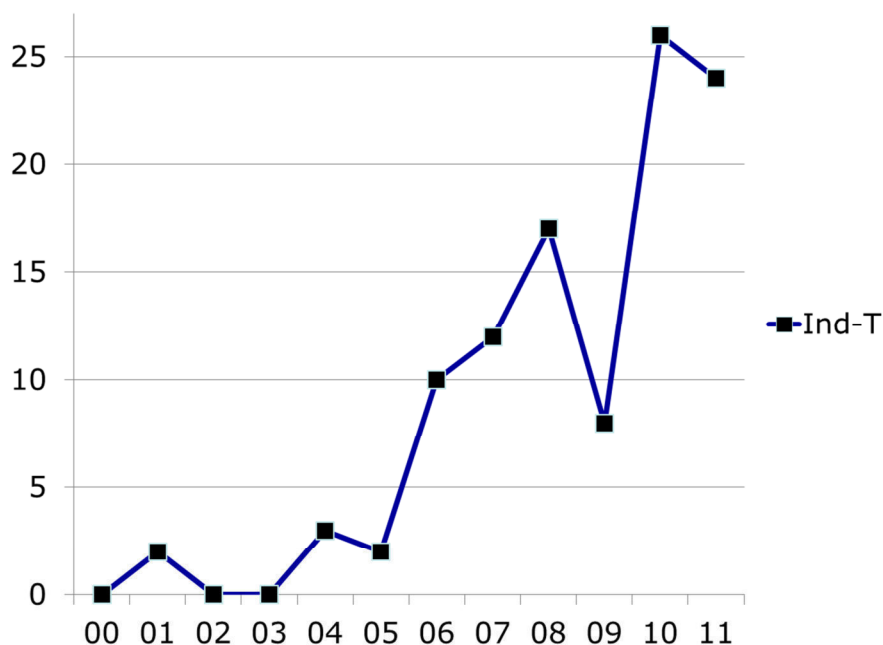
However, three programs experienced significant changes in graduation rates.

Consistent with national graduation rate trends, ECC's Computer Science and Information Technology programs experienced sharp declines. While ECC's Computer Science program has been relatively small, it did experience sharp declines. During the last decade, the year with the highest graduation rate was 2002, when twelve students graduated from the program. By 2009, that number had dropped to less than half. Information Technology also experienced sharp declines, a nearly a 50 percent drop from the highest point in the decade. Graduation rates for the two computer programs during the decade of 2000-2011 are shown in Figure 34.



**Figure 34. Graduation rates for ECC's two computer technology programs, Computer Science (CS) and Information Technology (Inf-T), experienced steep declines during the decade of 2000-2011.**

Surprisingly, one program within the scope of this study did experience a significant increase: ECC's Industrial Technology program. The program, which had been small, experienced sharp increases in both graduation and enrollment beginning in 2006. In 2005, the program had two graduates; by 2009, the program had 26 graduates and 24 graduates in 2011. The resurgence of students may be attributable to a donation in 2004 of \$500,000 in assets from the Metalworking Institute of Western New York that introduced a new machine-tools pathway (Kline-Date, 2011, para. 2). Graduation rates for ECC's Industrial Technology program during the decade of 2000-2011 are shown in Figure 35.



**Figure 35. Graduation rates for ECC's Industrial Technology program (Ind-T) increased during the decade of 2000-2011.**

Analyzing this data in total, enrollment in several of the technology programs continues to decline (IT, CIS, TE) while others are relatively stagnant, even as overall Buffalo State College enrollment is stable and continues to grow as shown in Figure 23.

While there is not a direct cause and effect between professional certifications and the decline in postsecondary college technology programs, the following conclusions may be made from observations of the data. Enrollment in degree-granting postsecondary technology programs is static or declining as professional certifications continue to grow. The analysis of localized enrollment and graduation data is consistent with national trends. The fundamental question of why enrollment in traditional technology programs is declining while at the same time job projections show increases and professional certifications have grown in popularity. To understand the perceptions



of the reasons for this, the researcher has measured perceptions from technology program alumni and faculty using survey and qualitative interview techniques.

**4.2.1 Perceptions of postsecondary college technology enrollment and recruitment.** The first problem aspect, technology program enrollment, analyzes and correlates Buffalo State College and ancillary community college enrollment to national trends. The scope of this study also included measuring perceptions of technology enrollment through interviews and surveys of Buffalo State College technology program alumni and selected other technology students and technology faculty.

One of the individuals interviewed for this study included Christopher (Chris) Weikel, a resident of New Jersey and 2011 graduate of the Rochester Institute of Technology (RIT). In his pursuit of a technical education, he was influenced in his choice by his father, who is an electrical engineer. Chris then participated in a program designed to test his aptitude for various college major fields of study. When his results came back, the test indicated he was best suited to study the field of nuclear engineering, but also showed he had a high aptitude for computer science and information technology. Chris chose to pursue a study of computers. When it came to selecting a college for his chosen major, after research conducted on the Internet, he had limited his choices to his top college selections: RIT, Rensselaer Polytechnic Institute, Drexel, and the University of Madison. Chris finally decided on RIT because of its direct involvement with students and their strong “co-op” network; where students participate in paid internships for which they also receive college credit (Weikel, 2010).

Another individual interviewed for this study was Mrs. Tehmina Ashraf, a computer science teacher and technology integration specialist at Westminster

Community Charter School (WCCS), a pre-Kindergarten through eighth grade public charter school (formerly known as Buffalo Public School No. 68), located in Buffalo's impoverished Kensington-Bailey neighborhood. In 1993, M&T Bank, through the vision of its chairman, Robert G. Wilmers, to improve educational attainment at one of Buffalo's lowest performing schools. That vision led to the selection of School No. 68 and the formation of the Westminster Community School Partnership, a collaboration of business, community, and educational representatives, formed to turn around the troubled urban school. Through years of work and dedication, that goal has gradually been realized and the school was reorganized as a separate New York State charter school. Currently, there are nearly 600 students enrolled at the school.

Mrs. Ashraf is responsible for the school's extensive computer network in its campus-like environment. The school has two 30-computer laboratories, as well as four-computer station pods in each classroom for students. The school also has other extensive educational technology solutions installed such as multi-media presentation equipment, distance learning technology, and smart boards. Mrs. Ashraf is a computer technology innovator and is founder of WCCS's Tech Savvy Divas Club, a computer club for girls to help them embrace "their geeky side and conquer the myths of technophobia." The club explores the history of computer technology, hardware, software, video game systems, trendy technology gadgets such as mp3 players, multimedia, the Internet/world wide web, and networking technologies. In addition to exploring what makes computers work, the club explores how they are beneficial to society, how they relate to science and math. A significant objective of the club is to expose girls to potential careers in science, math, engineering, and technology fields.

Ashraf also discusses certifications with her students. She has two certification:

CompTIA's A+ and Network+ certifications. Ashraf said:

I believe that certifications impart important knowledge and help to establish a learning community. However, I have also learned that most people outside of information technology really don't understand them.

Based on my experience, junior high (grades 6-8) is a pivotal time when academic interests are awakened and the foundations of college and career decisions are made. I created WCCS Tech Savvy to help open their eyes. Many of my students come from extremely impoverished families where they may be lacking positive role models or have an absence of examples for a girl's full potential. Even in this day and age, when I begin to have career discussions with some girls who demonstrate an aptitude in math and science, they often share their career vision is to become hair dressers, fashion designers, or home health care aides/nurses, because that is what they see women in their family doing. They never see women in technical roles. In March 2011, I brought my club to the University at Buffalo Tech Savvy conference focused on education and careers in technology for girls to reinforce the possibilities.

Created in 2006 by Tamara E. Brown, Buffalo Tech Savvy is an annual daylong conference at the University at Buffalo that aims to inspire middle-school girls to think about careers in the sciences. Brown, a project controller at Praxair, developed the first Tech Savvy event while serving as the president of the local chapter of the American Association of University Women. About 500 girls attend the annual event, including those from WCCS. For Brown's Tech Savvy efforts, she was honored at the White House on December 9, 2011 by President Obama's top science advisers who acknowledged her as a "Champion of Change" for building a better America (Zremski, 2011, p. A1).

Mrs. Ashraf also works closely with WCCS's Industrial Arts/Technology Education teacher, Mr. Michael Plewinski, a Buffalo State College graduate in 1991. Ashraf continued to explain:

WCCS's Technology Education program embraces computer technology and compliments our Computer Science program. Mr. Plewinski incorporates computer-based video production that captures the interest of our students. In addition, they take computers apart so students understand how they work and then reassemble them, and in some cases perform system upgrades. We have a great partnership. However, overall boys are still more enthusiastic than the girls in the Technology Education classes, which is the reason why I started the WCCS Tech Savvy Diva Club (Ashraf, 2011).

Mr. Plewinski concurs with Mrs. Ashraf about the lack of female students' and interest in Technology Education classes. However, with the full integration of digital technology into Technology Education classes, there may be more opportunities to capture girls' interest:

Computers and digital technology are fully integrated into our Technology Education classes. For example, we have a computer program that allows students to design roller coasters. While the digital technology allows them to envision far more elaborate designs than they could actually build, it inspires them, they get ideas from the process, and they learn about the laws of physics. They then compliment their digital experience by constructing a simplified version of what they have designed on the computer.

In our video production experience, while the camera will capture the all the students' interest, some students have a greater interest and aptitude. They often learn more about the tools than we teachers do and often teach us tricks that we didn't know about. Leaders often emerge from this group exercise as well.

In the fall of 2011, WCCS Technology Education students participated in EE Times' Innovation Generation, with Digi-Key and Microchip on a design challenge to inspire middle-school students to learn about electronics and use a microcontroller to control colorful light-emitting diodes. The theme for this challenge centers on community or school pride, so it is hoped this project will lead to inclusive participation (Plewsinski, 2011).

The role of Technology Education in developing a love of technology strikes a chord with Mrs. Ashraf from her own personal journey. She shared:

When I was in the seventh grade, I was allowed to choose, for the first time, several elective courses. I chose art and drama. When I told my father, he encouraged me to take Industrial Arts instead of art class. When I attended the class, I was a bit intimidated because it was mostly all boys in the class; there were only two girls. Yet after a short time, I started to have fun. We participated in woodworking activities and built solar cars. It was there that I learned I enjoyed technology and had an aptitude for it. Yet if it wasn't for my father's encouragement to take Industrial Arts classes, I probably wouldn't have the job I do today (Ashraf, 2011).

Another notable woman who was a technology leader in Buffalo and a BSC alumnus is Lian Sae Whitelaw Bloom. Mrs. Bloom was the third female to earn her B.S. Ed. in Industrial Arts at Buffalo State College, graduating in January 1959. Bloom says she "broke the technology glass ceiling" in the 1950s when cultural norms did not support women pursuing technology degrees. Bloom states as a student, she was always more of an applied learner. Her interest in Industrial Arts began while at Bennett High School on Main Street in Buffalo's Central Park/University Heights neighborhood:

It was the early 1950s and girls were not allowed to take Industrial Arts classes at Bennett. I spoke with the principal and asked him if I could take Industrial Arts classes. He told me that if I could find ten girls to take Industrial Arts, we could attend. I enlisted nine of my friends who were interested in taking Industrial Arts classes and I approached the principal. He then approved our admittance into the Industrial Arts program. I loved it!

Bloom certainly lived up to her personal high school senior motto: "Smile, with intent to do mischief" (Bennett Beacon, 1953, p. 44).

Bloom continued:

After graduating from Bennett High School in 1953, my mother encouraged me to pursue a college education, another rarity during the mid-1950s. I attended the University at Buffalo for six months but did not enjoy it. My mother continued to encourage me and suggested I attend Buffalo State Teacher's College. When I went to the admissions office, I opened the college catalog and the very page it opened to was the school's Industrial Arts program. I reviewed the requirements and thinking fondly of my high-school days, I decided *this is for me!*

As in high school, my choice was met with opposition. When I tried to apply for admission to the program, I was told by Buffalo State 'No, you can't take that curriculum. It is only for boys. Girls take Home Economics'. I was also encouraged by the college to take fine arts classes. When I saw the girls carrying their large art portfolios, I decided there was no way I was doing that. I wanted to pursue Industrial Arts and refused to be discouraged. Time was running out and I had to make a decision. The semester had already started four days before. I called the college on the phone and urged them to accept me into the program. I must have sounded determined, because they told me they would accept me, but I would be placed on probationary status. I had to prove myself within the program to remain enrolled.

I know I made quite an impression when I started the program. At first, the boys questioned my motives for enrolling into the program. However, it wasn't long before they accepted me as one of their own. I became just "one of the boys." I knew they completely accepted me when they felt comfortable enough to curse in front of me. It was the 1950s and that was never done in the presence of ladies! I also made it a cardinal rule never to date any of the boys in the Industrial Arts program. That immediately removed a great deal of tension from the environment. Throughout it all, my mother continued to support my academic choice, although my brother had concerns. He wanted me to quit my major, but my mother said to my brother: "let her be."

A photograph of Bloom and the 1958 Buffalo State Industrial Arts Club is shown in Figure 36.



**Figure 36. Buffalo State College Industrial Arts Club, 1958. Lian Sae Whitelaw Bloom was the program's third B.S.Ed. female graduate. She is in the second row, fifth from left. *The Elms*, 1958.**

Bloom continued her narrative:

My Industrial Arts student teaching assignment was at School No. 3, 255 Porter Avenue at the corner of Niagara Street.

At the time, the Industrial Arts program had an automotive curriculum component and I enjoyed working on cars. I created even more of a stir when I got a job during college working at a gas station repairing cars, and those were the big cars of the 1950s, not the small cars of today.

One of the most emotional experiences of my academic journey occurred during the graduation ceremony. Our class commencement took place at Kleinhans Music Hall on Sunday June 14, 1959. The way it was done back then was students were segregated by their major and each student would be called to walk across the stage to receive their diploma. In addition, the cum laude students, as well as summa and magna, were segregated from all the majors. I was not a cum laude student. Back then, only the cum laude students received applause as they received their diploma when they walked across the stage, and they were called first. When it finally came time for the Industrial Arts students to be called, they were arranged alphabetically and I was one of the last students to be called within the program because my maiden name was Whitelaw. However, as I walked across the stage, the whole audience began to clap because I was the only girl! I'll never forget experiencing the overwhelming emotion of being filled with such joy. Tears were streaming down my face as I walked across the stage.

After graduation, I moved to Manhattan where I taught Industrial Arts for seven years, including graphic arts, general shop, and ceramics. I learned to be an authoritative figure to New York's children. I really loved teaching Industrial Arts. I obtained my Master's degree in education in 1966. I must have also loved working at a gas station, because I also had a part-time job working at a gas station repairing cars in Harlem. I had a baby and was encouraged to stay home and take care of the baby, which I did for a number of years. After moving to Florida years later, I resumed teaching on a part time basis, where I taught a variety of subjects including general courses, Industrial Arts, and much later, computers.

Mrs. Bloom is an advocate of professional certifications, even obtaining a surprising one herself:

I'm 75 years old and have just received my certification as a spinning instructor. I started spinning classes for senior citizens at the YMCA. I'm

their oldest teacher, but that doesn't bother me. I've never been intimidated by people saying 'no'! I know some senior citizens are intimidated by the younger crowd at spinning classes and would be more comfortable attending classes if led by a fellow senior-citizen. I don't think it's ever too late to for personal growth and learning. I'm also working on my B.F.A. in ceramics from Florida University.

I believe women should pursue education and careers in technology. I did it over a half-century ago and I don't regret a single moment of it. Even after most people discouraged me, I still pursued it, and I was good at it! It's too bad gender inequality still exists, so many years later. I hope my experiences can inspire others. When I look back it, I was just determined to do what I wanted to do. I really hadn't considered the enormous undertaking of challenging society's deeply held notions of what was acceptable behavior for men and women. I was just an ordinary girl who knew what she wanted. Yet if just one girl can be inspired to pursue a career and educational path in technology because of my personal journey, it will really make me feel as though I have accomplished something truly extraordinary (Bloom, 2011).

In addition to perceptions gathered from these interviews, several survey respondents also shared their perceptions of postsecondary college technology enrollment. A sampling from respondents who shared why they chose their technology field of study said:

- "I was interested in cars and my father's current job position."
- "I was dabbling in computer programming at work and wanted to learn more."
- "I always wanted to teach. I had a Technology teacher in high school that influenced me to go into the field that I did."
- "I had enjoyable technology experiences while I was in school."
- "I originally registered at Buffalo State as an undergraduate in Journalism/Broadcasting but subsequently took a variety of other courses to fulfill my other requirements, including the ISM 111 class, which then sparked my interest in computer programming/management."
- "I wanted to be able to influence manufacturing practices in order to increase production."



- “Since a teenager I learned how to repair and maintain radios and televisions. I began my formal education and received an A.A.S. in Electrical Technology. I also passed the exam required for a F.C.C. 1st Class Radiotelephone Operators License with Radar Endorsement. I loved most areas of Technology and that made it easy for me to major in technology.”
- “I did well in my introductory classes at Erie Community College and thought I might as well pursue advanced studies at Buffalo State College.”
- “I have always had an interest in computers and have always been good with them. I chose my major because I wanted to learn even more and have a career using computers.”

Most of the survey respondents indicated they were influenced in their career and academic field of study based on the influence of a parent or teacher. In addition, 80 percent said their job was strongly or moderately correlated to their field of study and 67 percent said their choice of a BSC program strongly or moderately prepared them for their job. Survey respondents indicated several suggestions for increasing enrollment for the six programs within the scope of this study. Suggestions included:

- “A stronger network of internships in the 3rd and 4th year of study and career assistance to find positions in one’s field of study after graduation.”
- “Personal testimonials provided to high school students from those alumni who have graduated with similar degrees and who can now vouch for their effectiveness as well as inform them where their education has since taken them.”
- “Technology at this moment is all around us. Technology hardware and software manage much of world. Our daily life is exposed to technology advancements multiple times throughout the day. Technology fairs, internet sites and general media that promote college technology programs are a start. Students have to be invited to participate in learning technology and how it can make a difference in their careers and daily lives.”
- “Show the connections to jobs related in the fields of technology. I think many students are concerned about where they can find jobs or what's in demand.”
- “Focus more on lean manufacturing and possibly Six Sigma certification. There are so many jobs that I have been looking at that require lean manufacturing training.”

- “Expose grade school and high school students to some of the more interesting outcomes of technology studies. Examples of some of the graduate projects or programs could help plant the seed of interest.”
- “Showing students all the amazing things that can be done with technology would strongly help. I feel this way because that is one of the ways my own interest increased.”

Closely related to the question of methods to increase enrollment was the question about what attracted alumni to the technology programs at Buffalo State College. A sampling of those responses included the following:

- “Of the two colleges that offered Technology Education, Buffalo State was closer.”
- “Buffalo State College is local and affordable.”
- “I selected the University of Buffalo based on the variety of programs and size of the institution. When I started, I had a strong interest in pursuing a career in medicine and quickly found that I was more suited to math and computer science.”
- “I looked forward to the one-on-one mentoring with professors.”
- “Buffalo State College has an excellent Industrial Arts teaching program. Its location being close to home was also a factor.”
- “Financial restrictions kept me to local schools; I was more interested in the software and solution factors of the CIS program at BSC than the hardware focus offered by the CS programs at UB and other institutions.”
- “It was very natural for me to trend toward Technology Education and Buffalo State has a fantastic program. The college staff, at the time, was previously industry-trained and this gave me an upscale education. Also I wanted to make sure my college of choice had a Master’s program to complement the Technology Education major.”

Related to the enrollment in technology programs is the new delivery channel of Internet computer-based education. Of the survey respondents, only 50 percent answered the question relative to the quality of online technology classes. Thirteen percent believed the quality of online classes was the same as traditional classes.

### **4.3 Perceptions of student/employer value and awareness of professional certifications**

Data were captured for two sources to measure the perception of the value of professional certifications and need for awareness. Because professional certifications often have very different perspectives among employer and employee, two sources were required. Interviews were made with business leaders, professional certification exam preparation authors, certification vendors, and hiring decision makers to establish the value of professional certifications from an employer's perspective. In addition, surveys were used to poll graduates from Buffalo State College's technology programs within the scope of this study to measure their perceptions of the value of professional certifications as well as the need to make students aware of the existence, relevance and significance of professional certifications.

**4.3.1 Perceptions of Professional Certification Value.** Several interviews were performed to determine the value of a certification from an employer and certification organizational perspective.

Rick Coscarelli, of ATMAE, believes certification of any kind will help a student differentiate themselves from others during the hiring process. Additionally it will help keep them abreast of current activities as they keep their certification current via the pursuit of continuing educational units (Coscarelli, 2011).

Matthew Speare, another individual interviewed during the course of this study, is uniquely qualified to share his opinions about the value of professional certifications. Mr. Speare is a Senior Vice President and Division Manager of Central Technology and Information Security for M&T Bank. The company was established in Buffalo, New

York in 1856 and now is one of the 20 largest U.S.-headquartered commercial bank holding companies with nearly 13,000 employees. As of June 1, 2011, M&T had assets of \$79 billion and more than 780 branches located in New York, Maryland, Pennsylvania, Washington, D.C., Virginia, West Virginia, New Jersey, Florida, Delaware and Toronto, Canada (M&T Bank, 2011, para. 1).

Mr. Speare is a retired U.S. Army Lutenient Colonel, Boeing AH-64D Apache attack helicopter pilot, and was awarded the Legion of Merit and Distinguished Flying Cross. He is currently a Major in the Army National Guard, serving as the 42nd Infantry Division Aviation Operations Officer.

In addition to his responsibilities at M&T Bank, Mr. Speare also teaches a Cisco Certified Network Administrator (CCNA) class. Mr. Speare earned his Bachelor's degree in Industrial Engineering Technology from Ohio State University and Master's degree from East Carolina University. He currently holds a Cisco Certified Internetwork Expert (CCIE) certified and was one of the first Cisco Certified Network Professionals (CCNP) east of the Mississippi River. He stated: "To me, a college diploma and professional certification demonstrates a job candidate is goal-oriented and has perseverance, two traits I find admirable."

Mr. Speare became involved in the computer industry through his career in the U.S. Army. While splitting time studying Industrial Engineering at Ohio State and his career in the U.S. Army, he was responsible for maintaining a \$100 million inventory of helicopter parts. The inventory system was a manual, paper-based system and when components were out of supply, it had a devastating impact on the ability to keep helicopters in working condition. Mr. Speare decided to investigate how Wal-Mart

managed their inventory supply chain. He implemented a system similar to Wal-Mart using a Microsoft Structured Query Language (SQL) database server, bar codes and a scanning device. To support this effort, he earned his Microsoft Certified Systems Engineer (MCSE) certification through self-study.

While Speare's initial foray into certifications was through Microsoft, he chose to focus on Cisco certifications:

I believe Cisco certifications are by far the best in the computer industry. Not only do they have an advanced training program through the Cisco Networking Academy, but they also use an advanced and effective computer-based adaptive testing model that ensures those who become certified have a mastery of the subject matter. In addition to Cisco, I believe certifications offered by Microsoft and the Project Management Institute have great value.

I particularly enjoy teaching technical classes. It is personally rewarding for me when a student overcomes learning struggles, such as executing a set of tasks to create an Internet Protocol subnet. It's not the material is particularly difficult, but it introduces perhaps a very different way of approaching a problem than the student is used to. Then all of the sudden a light bulb will go off and understanding occurs.

I do believe in the value of professional certifications and think it's important students try a variety of different things until they find their passion, and then to pursue it with vigor (Speare, 2010).

Another individual interviewed for this study expressed a slightly different perspective. Mr. Clark Crook, is the former president of Synergy, Inc., the largest computer technology solutions provider in Western and Central New York State. Founded in 1971 as Western New York Computing Systems in Rochester, today, the employee-owned company employs more than 225 associates including 85 computer engineers. In 2004 the company merged with premier technology integrator and service provider, Synergy, Inc. and annually produces approximately \$65 million in revenue. In addition to offices in New York State including Rochester, Buffalo, and Syracuse,

Synergy also maintains offices in Baltimore, Maryland. In 2011, EarthLink Inc. purchased Synergy's IT Solution Center and hosted application business for nearly \$5 million. Mr. Crook is presently Vice President of Managed Service Provider Operations for EarthLink Business. Crook stated:

Professional certifications are very important to Synergy. CompTIA's A+ and Network+ certifications form the basic foundation for a career in the information technology sector. An assumption in today's work environment is employees have excellent critical thinking skills and communication skills, but ultimately, it is their specific technical knowledge that gives them an edge and keeps them competitive. For example, one of my employees has a Ph.D. in English. While I can't deny the value it brings to some of the communication tasks he performs, in reality, it is his ITIL certification knowledge he uses every day as manager of one of our operations areas. Professional certifications are a measurable, transportable, globally-recognized commodity, valuable like currency.

Our employees are encouraged to obtain certifications relevant to their current jobs as well as their future interests. Obtaining a certification is an investment of time and money and Synergy co-invests with them. Synergy purchases study guides for CompTIA's A+ and Network+ certifications as well as a self-study certification guide for Microsoft Certified Server Engineer (MCSE). Synergy will also pay for testing. Each employee develops their own career development plan and has it approved by the company.

Cisco is far and away the best in developing value certifications. An organization like Synergy can charge \$250 each hour for a CCIE skill set. Frankly, we couldn't obtain as high of service rates if our engineers were not certified. Not only are certifications valued by our customers, but even among peers, they know how challenging it is to obtain a Cisco certification and those who hold it earn instant respect.

In addition to Cisco, CompTIA, and Microsoft, other important computer-related certifications include ITIL, Six Sigma, and CISSP (the only other certification that compares to Cisco in terms of value).

In concluding his discussion of the value of certifications, Mr. Crook emphasizes their global appeal:

As a father of three grown children, parenting advice popular during the time I was raising my children said to them “Be anything you want!” Often that resulted in choosing college programs and jobs in the arts or social sciences. Still, we have business to do and over the last twenty or thirty years, a complete business transformation has taken place, driven by technology. Professional certifications have fulfilled an important role of providing an increasingly global world with something locally meaningful. More and more certification holders are from outside the United States. It seems to me Information Technology jobs are the new American job that Americans don’t want to do. It’s the twenty-first century equivalent of the migrant worker apple-picking job (Crook, 2011).

William Bryan Clements, Group Vice President of Technology Infrastructure at M&T Bank, agrees with Mr. Crook on the most valuable certifications being those from Microsoft and Cisco. However he adds: “experience trumps all else when it comes to hiring someone for a particular job.” (Clements, 2010).

When Buffalo State alumni were questioned about the value of professional certifications, 75 percent of them indicated relevant professional certifications were important to augment a traditional technology college education.

Besides BSC alumni, within Buffalo, decision makers at the secondary school level also believe certifications are important and strive to integrate them into existing secondary curricula. Katherine M. Heinle, Director of Career & Technical Education for Buffalo Public Schools said:

Certifications are encouraged by the State of New York. Buffalo’s high school career and technical education curricula include 26 programs that include 810 hours of instruction for each program. I believe certifications are very important to integrate into all our career and technical educational curricula and create a foundation of value by itself and can be built upon at the postsecondary level.

Our computer engineering curricula is in flux right now. We had integrated Cisco CCNA certification for a number of years, but when Jacobs Executive Development Center at the Butler Mansion was no longer a Cisco regional hub, the Buffalo Public Schools ceased offering it. Our computer engineering program starts off with an electrical

engineering base during the freshman and sophomore year and spins off into its own curriculum during the junior and senior year.

Erie Community College is now the hub of the Cisco CCNA certification and we are considering integrating that back into the Buffalo Public School computer curriculum. However, some educators have raised concerns that while the certification is undeniably of value and is one of the best, the content might be too specific to Cisco's networking technology. We will be exploring other certifications, but we recognize the value of the certification and the quality of the Cisco Networking Academy materials. For our electrical and mechanical engineering programs, we use NOCTI certifications (Heinle, 2011).

Some educators see the value of professional certifications not only at the secondary level, but also at the postsecondary level. One-Stop Career Centers, which began in New York State approximately in 1990, were created to combine employment and training services for dislocated workers, disadvantaged workers, veterans, elderly, the disabled and single parents who received welfare. While the One-Stop Career Centers began as a proactive experiment, their influence grew when they were mandated under the 1998 Workforce Investment Act (WIA) (Jacobson, 2009, p. 7). The WIA (Public Law 105-220) was signed into law on August 7, 1998 and extends until 2012. The WIA replaced the Job Training Partnership Act with workforce investment systems that induced business to participate in the local delivery of workforce development services. To facilitate this, Workforce Investment Boards were created and chaired by private sector members of the local community.

At the One-Stop Centers, job seekers receive a preliminary assessment of their skill levels, aptitudes, abilities and support service needs. They also receive information about local education and training service providers. The WIA/One-Stop divides its services into core and intensive services. Core services are available to all adults with no eligibility requirements. Core services include job search and placement assistance as



well as initial assessment of skills and needs. Intensive series include more comprehensive assessment, development of individual employment plans, group and individual counseling, and short-term pre-vocational series. Where qualified job seekers receive intensive services and are still not able to find jobs, they may receive training services which are linked directly to job opportunities in their local area (U.S. Department of Labor, 1998, pp. 5-6). One of the options relating to training is the use of certifications.

In the Western New York area, there are two One-Stop Career Centers: Buffalo Employment and Training Center in Buffalo (BETC) and the Erie Community College (ECC) Employment and Training Center in Orchard Park.

At the ECC One-Stop Center, funded by the Buffalo and Erie County Workforce Development Consortium, the following services are provided: Microsoft Office computer classes, career preparation workshops, résumé assistance, tuition grants for eligible students, career counseling, job search assistance, Internet access, labor market information, postage, and referrals to other federal, state and local agencies (Erie Community College, 2008, p. 57).

Mark G. Cosgrove, Senior Planner with the Buffalo and Erie County Workforce Investment Board said that government-funded certification training is possible:

Through Buffalo and Erie County's One-Stop system, eligible individuals can receive individual training accounts (ITA) worth up to \$2,400, as long as the training leads to employment in a demand area. To be eligible for an ITA, one has to be a dislocated worker or fit under the 70 percent Lower Living Standard Income level. It is also possible to obtain a professional certification with ITA funding. As long as the certification is achieved with an occupation in demand, we would most likely grant this person an ITA (Cosgrove, 2011).

As an example of how government funding may be used for certification training, many technology-related jobs now require candidates to have earned the American Society for Quality (ASQ)'s Six Sigma Green Belt or Black Belt certifications. The training cost for the certification is significant: \$4,400 for Black Belt and \$2,400 for Green Belt certification. However, unemployed residents of Erie County may receive up to \$4,400 from the New York State Department of Labor through the BETC defray the cost of training for the certification (Lupiensi, 2011, p. 6).

Another Buffalo postsecondary workforce training focused educational institution that provides professional certification preparation is the Adult Education Division (AED) of the Buffalo Public School District, which services over 6,500 adult students each year. The AED provides computer-based certification classes using both traditional instructor-led classes at its school at 389 Virginia Street in Buffalo and distance learning instructor-led classes online through the Internet.

Within its traditional classrooms, it offers both Microsoft Office (2007 and 2010) Specialist (MOS) certifications and the CompTIA A+ certification. For the Microsoft certifications, the AED works in partnership with the Buffalo Educational Opportunity Center (EOC)/Martha Mitchell location for certifications based on Certiport testing.

In addition to its ability to offer Microsoft classes, the AED is also CompTIA Authorized Academy. In its distance learning Internet-based courses, AED offers five classes for three CompTIA certifications: A+ (basic, intermediate, and advanced); Network+; and Security+. Each of the Internet-based classes cost about \$100 (or about \$300 for the three A+ classes); in comparison, the traditional instructor-led A+ certification class is \$1,450 which includes 180 hours of instruction (twelve week

course), text books, and vouchers to take the two required A+ certification exams.

According to Mr. Lester B. Leopold, Director of Adult and Continuing Education for Buffalo, “tuition assistance is available for qualified students through the BETC One-Stop or Vocational and Educational Services for Individuals with Disabilities (VESID)” (Leopold, 2011).

Ed Tittel, who was also interviewed for this study, offers a unique perspective on the value of professional certifications and their role as a complimentary credential to traditional two or four-year degree granting postsecondary technology programs. Mr. Tittel is a 28-year computer industry veteran with a background in the social sciences. A graduate of Princeton and multiple University of Texas graduate, Mr. Tittel started his academic career with undergraduate and graduate degrees in anthropology. He is also an author of an over 140 books on computers and an expert in computer-related professional certifications. Mr. Tittel understands the value of both a traditional technology degree and professional certifications:

Employers want employees who have both a degree and a certification (or multiple certifications). There are now interesting ways that didn't exist ten years ago to combine those two things in the process of pursuing a degree at the Associate, Bachelor, or in some cases, even at the Master degree level. Education, training, and technical skill are all important ingredients for preparing oneself for a long-term position in the workforce.

A very interesting trend I see happening in the world, and this applies as much to the use of the Internet and to mobile computing platforms (as recent events in Egypt clearly show us), is emerging markets are leapfrogging and/or outpacing developed markets in use of online productivity suites. We have a very important mission if we want to keep ourselves and the United State in the forefront of using technology to keep up with what's new and interesting and to make sure we know how to use it. To a large extent, that's where both education and professional certifications come into play.

When it comes to taking what you learn in school and bringing it to work, the combination of a degree and certifications is better than either one of those things by themselves. A college degree is a very good testament of one's ability and willingness to learn, and the fact that one has put two, four, or six years into studying a particular discipline. Yet the truth of the matter is once you are in the workforce for five to ten years what you learned in school really doesn't have much to do with what you're doing on the job anymore. That's where certifications come into play. They are what enable technical employees to keep current with the latest tools and technologies and to make sure they really know how to use what's important to them in their current jobs or other jobs they want to pursue. To put it succinctly, a degree is a lifelong credential whereas most certifications must be renewed every one to three years, or else the certifications may only be valid as long as the associated technology platform exists.

No matter who you talk to (either employers or employees), there is value in certification. For those seeking employment or advancement, if you have a degree and a certification, it may very well catch a decision-maker's eye and merit an interview or job offer.

Mr. Tittel is an advocate for the integration of professional certifications and degrees, but feels two-year degree-granting institutions are leading the way:

In many ways community colleges have led the charge to bring job-oriented technology training into the curriculum. The reason is simple: most community colleges have a strong charter from their local surroundings and are usually funded by property taxes or some other form of taxes in their local jurisdiction and have an arrangement with employers where employers tell them what kind of training they want to provide so students graduating from those institutions will be ready to go to work for them. During the eight-year period between 1996 – 2004 I taught at Austin Community College, I included Microsoft Windows NT and 2000 Server into the curriculum. I saw many students graduate with an Associate's degree, coupled with a MCSA certification, go right into the workforce. The integration of professional certifications into a degree program is a very powerful tool, not only to motivate students to get their degree and get through the curriculum, but also it is a terrific way for them to find their place in the workforce. It is important for four-year colleges to remember the needs of the student and to be aware of current trends in the educational arena and professional certifications are here to stay and should be evaluated within four-year programs, integrated where appropriate and minimally, make students aware of their existence.

In conclusion, Mr. Tittel said students should pursue both a degree and professional certifications to make them attractive to employers:

Earn as many degrees as you can and pursue certifications to develop and hone job skills. People should stay in the educational system and pursue as many degrees as they can. A degree is a one-shot deal. Certifications are helpful because they are designed to be of limited duration, but of extreme currency so what you learn is valid in the workplace right away and should stay valid for at least two to three years after you learn it. If you work in technology, you are on a path of lifelong learning. Certifications represent what I call a career ladder where you can go from entry-level to intermediate to more senior to capstone or pinnacle certifications. Yet you can mix and match professional certifications for your own needs. If you want to keep earning, you have to keep learning and growing. There's no other way to get ahead in this world and there is no other way to get ahead in information technology (Tittel, 2011).

Those BSC alumni who took the associated survey in this study concurred with those interviewed. Eighty percent of survey respondents indicated certifications have value. Those same 80% also said certifications were important to augment a postsecondary college degree. Eighty percent also said professional certifications could never take the place of a postsecondary college degree.

**4.3.2 Perceptions of Professional Certification Awareness.** When researching the need for awareness of relevant professional certifications to postsecondary college technology students, 100 percent of Buffalo State alumni who took the survey said there should be a mechanism to make college students aware of relevant professional certifications and 53 percent said they already have relevant certifications in their field of study and/or profession. Chris Weikel, a recent graduate of RIT, said "I think colleges should talk to students and make them aware and get them information on certifications" (Weikel, 2010).

Some certification organizations have been able to increase awareness by establishing local chapters on college campuses. One such certification organization is the American Society for Engineering Management that operates a chapter at Western Michigan University as does the Society for Manufacturing Engineers (Western Michigan University, 2010). This approach is closely related to efforts to integrate professional certifications into postsecondary college programs.

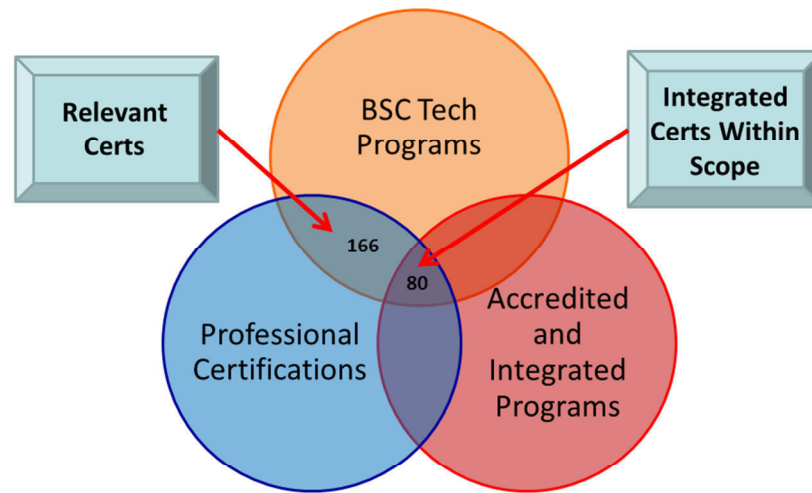
#### **4.4 Relevancy and integration of professional certifications in Buffalo State College's traditional technology programs.**

The third aspect of this study was to correlate relevant professional certifications to Buffalo State College's six technology programs within the scope of this study as well as measure perceptions of certification integration with postsecondary college technology programs. Of those who BSC alumni who participated in the survey, 100 percent indicated they believe certifications should be integrated with postsecondary college technology programs.

A total of 36 professional certification organizations and eight accreditation organizations were identified within scope and are listed in Appendix Seven with their headquarters and contact information. The 36 certification organizations were sent a questionnaire included in Appendix Six. In addition to the results of the questionnaire, each organization also maintains an Internet-based website used to gather data. The results of the questionnaire are recorded in Appendix Five.

Of the 36 certification organizations identified, 31 are vendor-neutral and five are vendor-specific. The 36 certification organizations had a total of 166 certifications relevant to the six program areas within the scope of this study. Of those, 80 were

directly integrated with postsecondary college programs or accredited with postsecondary integration by accreditation bodies relevant to the six areas of the scope of the study. Several more certifications had integration with high school programs as well. The intersection of these areas is represented in Figure 37.



**Figure 37. Venn Diagram showing number of professional certifications within scope of study and number of integrated/accredited certifications.**

A number of data elements were tracked that included characteristics associated with training, testing difficulty, etc. However, the three data elements that are of particular value to the scope of this study are:

- Year created
- Number of certification holders/number outside the United States
- Level of integration

The data will be disclosed in sections 4.4.2 through 4.4.7 in the following portion of this study. The distribution of these certifications as they correlate to the six technology programs within the scope of this study is depicted in Figure 38.

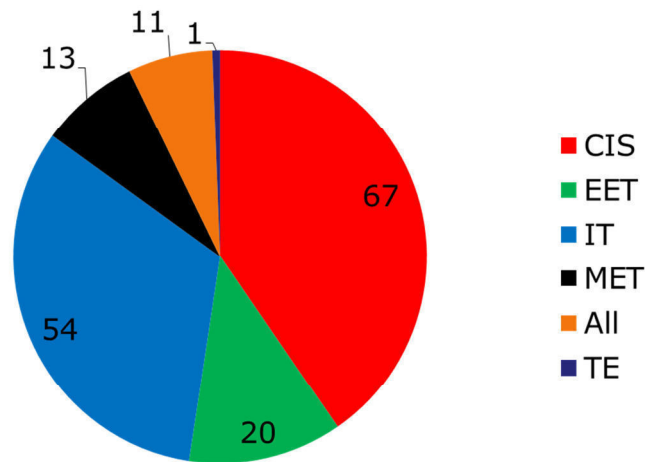


Figure 38. Professional certifications correlated to BSC subject area: Computer Information Systems (CIS); Electrical Engineering Technology (EET); Industrial Technology (IT); Mechanical Engineering Technology (MET); Technology Education (TE); and certifications relevant to technology programs within scope of study.

**4.4.1 Accreditation Organizations.** In addition to individual integration of the various certifications into existing postsecondary college programs, a number of professional certifications are accredited by independent organizations, many for college credit. By far, the two largest are ACE and ANSI, although all accreditations are significant. Organizations included within the scope of this study are described below:

**4.4.1.1 American Council on Education (ACE).** ACE is an organization established in 1918, which comprises over 1,800 accredited, degree-granting colleges and universities and higher education-related associations, organizations, and corporations (including Buffalo State College).

**4.4.1.2 American National Standards Institute (ANSI).** ANSI is a private non-profit organization that oversees the development of voluntary consensus standards for products, services, processes, systems, and personnel in the United States. The organization also coordinates U.S. standards with international standards so American



products can be used worldwide. ANSI also accredits organizations that carry out product or personnel certification in accordance with requirements defined in international standards.

**4.4.1.3 Council of Engineering & Scientific Specialty Boards (CESB).** CESB is a membership-based body created for its member organizations who recognize, through specialty certification, the expertise of individuals practicing in engineering and related fields. Its creation on April 24, 1990 was the culmination of organizing work by volunteers from among the 130 attendees (23 organizations represented) who participated in the April 1988 National Conference on Engineering Specialty Certification.

**4.4.1.4 International Certification Accreditation Council (ICAC).** ICAC is a not-for-profit organization founded in 1996 for the purpose of evaluating certification programs. The ICAC is an alliance of organizations dedicated to assuring competency, professional management, and service to the public by encouraging and setting standards for licensing, certification, and credentialing programs internationally. The organization primarily accredits electronic and telecommunications certifications. Most of the certifications and associated training from organizations accredited by ICAC have postsecondary college credits associated to their programs as a result of the ICAC accreditation. ICAC focuses on the accreditation of the organization's licensing, certification, and credentialing programs as defined by ISO/IEC 17024 standards.

**4.4.1.5 International Cost Engineering Council (ICEC).** ICEC is a nonprofit international organization, the organization's objective is to promote cooperation between cost engineering, quantity surveying and project management organizations.

**4.4.1.6 National Commission for Certifying Agencies (NCCA)/Institute for Credentialing Excellence (ICE).** ICE is a membership-based non-profit organization dedicated to providing educational, networking and advocacy resources for the credentialing community. The organization was founded in 1977 as the National Commission for Health Certifying Agencies (NCHCA) in cooperation with the federal government to develop standards of excellence for voluntary certification programs. In 1989, the scope of those standards was broadened to include certifications for individuals in all professions and occupations and the organization's name was changed to the National Commission for Certifying Agencies (NCCA).

At that time, an associated organization, the National Organization for Competency Assurance (NOCA) was created as the membership association for credentialing bodies. In 2009, NOCA's name was changed to the Institute for Credentialing Excellence (ICE). ICE's accrediting body, the National Commission for Certifying Agencies (NCCA), evaluates certification organizations for compliance with the NCCA Standards for the Accreditation of Certification Programs. It does not appear that any degree-granting postsecondary educational institutions presently use the NCCA accredited certification programs as a basis for college credit. In some professions, state regulations require an individual become certified through an accredited program.

**4.4.1.7 National Institute for Metalworking Skills (NIMS).** Formed in 1995 by the metalworking trade associations to develop and maintain globally competitive American workforce. NIMS sets skills standards for the industry, certifies individual skills against the standards and accredits training programs that meet NIMS quality requirements. NIMS operates under rigorous and highly disciplined processes as the

only developer of American National Standards for the nation's metalworking industry accredited by the American National Standards Institute (ANSI).

#### ***4.4.1.8 National College Credit Recommendation Service (NCCRS).***

Established in 1973, the NCCRS is housed within the New York State Education Department in Albany, New York. It is an educational advisory service that links learning experiences that take place outside of college classrooms to college degrees. NCCRS evaluates learning experiences for non-collegiate organizations throughout the United States and overseas and makes the results available on its directory, College Credit Recommendations Online (CCR Online), for colleges to use as a guide when awarding credit for non-collegiate course work. While BSC is not on NCCRS's list of cooperating colleges, Erie Community College and the University of Buffalo both are, and both have articulation or transfer agreements with BSC's technology programs.

**4.4.2 Certifications Relevant to All Technology Programs.** Based on the research from this study, four certification organizations (all vendor-neutral) had eleven certifications relevant to all six of the BSC technology programs within the scope of this study. They are detailed in the sections below.

***4.4.2.1 Association for the Advancement of Cost Engineering (AACE).*** AACE is a nonprofit professional educational association founded in 1956 by 59 cost estimators and cost engineers during the organizational meeting of the American Association of Cost Engineering at the University of New Hampshire in Durham, New Hampshire. The organization globally serves the entire spectrum of the cost and management profession.

Three certifications AACE offers are included within the scope of this study. AACE's flagship certification is Certified Cost Consultant (CCC)/Certified Cost

Engineer (CCE). The certification was created in 1976 and is accredited by CESB and ICEC. Of those certification holders at the time the survey was completed for the course of this study, there were 1,699 holders, 829 of whom were from outside the United States or 49 percent.

**4.4.2.2 Project Management Institute (PMI).** PMI is the world's leading not-for-profit membership association founded in 1969 for the project management profession, with more than a half million members and credential holders in 185 countries. Its worldwide advocacy for project management is supported by its globally-recognized standards and credentials, extensive research program, and professional development opportunities. Countries with significant PMI memberships include Australia, Brazil, Canada, China, France, Germany, Hong Kong, India, Italy, Japan, Mexico, New Zealand, Saudi Arabia, Singapore, South Korea, Taiwan, United Arab Emirates, United Kingdom and the United States (Project Management Institute, 2011, para. 2).

PMI's flagship certification is the Project Management Professional (PMP), created in 1984. It is the only certification from PMI within the scope of this study that is accredited by ANSI. A total of five certifications are included within the scope of this study and are applicable to all of the technology programs. These certifications are enormously popular and have broad international appeal.

In addition to the ANSI certification both the PMP certification and one other, the Certified Associate in Project Management (CAPM) is accredited by ACE if the associated training classes are taken through SkillSoft, a for-profit training company. SkillSoft PLC is an Irish-based leading provider of Internet computer-based distance

learning. SkillSoft was incorporated in 1989 and in 2002 merged with SmartForce, a leader in information technology courseware.

**4.4.2.3 The Society for Standards Professionals (SES).** First known as the Standards Engineering Society, SES was founded in 1947 as a non-profit, technical association dedicated to furthering the knowledge and use of standards and standardization. SES's members are standards developers, users, managers, and information specialists from industry, government, standards developing organizations, trade associations, and academia. Two SES certifications are included within the scope of this study, a certified standards professional and associate certified standards professional.

**4.4.2.4 Computing Technology Industry Association (CompTIA).** One other certification is listed in this category: the Project+ certification from CompTIA. CompTIA, primarily a computer-based certification company, will be discussed under section 4.4.7.3.

**4.4.3 Certifications Relevant to Industrial Technology.** Besides Computer Information Systems, Industrial Technology had the highest number of relevant professional certifications. This might not be surprising given how manufacturing is changing from traditional shop-floor skill sets to high-tech skill sets. Michael Weaver, director of engineering, science and technology at Jamestown Community College said "Manufacturing is an application-based industry. It's hands-on and workers need up-to-date skills. In this technological age . . . you have to keep up" (Kline-Date, 2011). Fourteen certification organizations (two of which are vendor-specific) were identified, representing 54 professional certifications.

**4.4.3.1 American Society for Quality (ASQ).** Originally called the American Society for Quality Control, the organization was formed in 1946 by 253 members of 17 quality-related societies. Members from a Buffalo society became some of the founding members of the centralized organization. In 1943 an organization called the Society of Quality Control Engineers of Buffalo was formed with 41 members and the following officers: C. Wing, president; Dr. Martin A. Brumbaugh, vice president; V. Grom, secretary; and G. Harrold, treasurer. By 1944, Brumbaugh, a statistics professor at the University of Buffalo, advocated for a national organization of quality control practitioners. In addition to his role as vice president of the Buffalo organization, he also served as editor of its newsletter, *Industrial Quality Control*, first published in July 1944. In 1946 Brumbaugh chaired the organizational meeting that launched the American Society for Quality Control with George Edwards, director of quality assurance at Bell Telephone Labs, being elected the new national organization's first president. The Society of Quality Control Engineers of Buffalo then became the Buffalo Section (0201) of the American Society for Quality Control and *Industrial Quality Control* became the Society's national newsletter, later succeeded by the *Journal of Quality Technology and Quality Progress* (About Section 0201, para. 1-4). The organization was originally intended for quality experts and manufacturers to create methods to sustain the many quality-improvement and efficiency techniques developed and used during World War II (American Society for Quality, para. 2).

Today, the nonprofit organization has 85,000 members. Although headquartered in Milwaukee, Wisconsin, ASQ has a significant global presence and supports membership services and business operations through ASQ Global, ASQ China, and

ASQ Mexico; and with ASQ world partners. ASQ offers a significant number of professional certifications. Within the scope of this study, ASQ has 12 professional certifications, the three most popular of which were the engineer (CQE), followed closely by the auditor (CQA) and the Six Sigma Black Belt (CSSBB). In addition, ASQ offers three more certifications in conjunction with the Society of Manufacturing Engineers (SME), the Association for Manufacturing Excellence (AME) and the Shingo Prize for Operational Excellence: Lean Certification in bronze, silver and gold categories. ASQ was an early proponent of certifications; the CQE certification was created in 1968, although half of their current offerings were created since 2000. None of ASQ's certifications are accredited, although they have integration with some postsecondary programs. ASQ certificate credentials may be used to earning up to 24 credits toward a Rochester Institute of Technology (RIT) undergraduate program. According Fred Walker, dean of RIT's College of Applied Science and Technology as described in *RIT and the American Society for Quality Sign Educational Partnership* (para. 4), "the program brings together the power of ASQ certifications with the global recognition of RIT's quality engineering and quality management programs, to create exceptional educational opportunities for ASQ certified professionals" (Cometa, 2009).

Most ASQ certifications are valid for three years, however, others are not. Jim Schraven, ASQ Buffalo Section Recertification Coordinator stated:

some ASQ certifications are one-time certifications: once they are awarded, they are retained permanently, with no recertification requirement. Those include: Certified Quality Technician (CQT), Certified Quality Improvement Associate (CQIA), Certified Quality Process Analyst (CQPA), and Certified Six Sigma Green Belt (CSSGB). I consider the CQIA certification to be a very worthwhile but underappreciated certification" (Schraven, 2012).

Buffalo State College's Technology Department has a Quality minor undergraduate field of study.

**4.4.3.2 Association for Facilities Engineering (AFE).** AFE is a nonprofit member-based organization founded in 1954 as the American Institute of Plant Engineers. The objectives of the organization when founded were to further the professional interests of the plant engineer; to foster the developments of this specialized branch of engineering in the Western Hemisphere; and cooperate throughout the world with compatible organizations having similar objectives and concerned with exercising responsible supervision over the design, layout, construction, maintenance, operation and/or control of fixed or mobile industrial plants or facilities. The organization became involved certification programs in November 1975, when it developed a new program to certify plant engineers and 400 professionals were certified the first year. Its flagship program is the Certified Plant Engineer (CPE), of which there are two variants: category A and category B. In addition to CPE, two other certifications are included within the scope of this study. None of AFE's certifications are accredited.

**4.4.3.3 Association for Manufacturing Excellence (AME).** AME is a not-for-profit membership based organization founded in 1985 to promote lean manufacturing initiatives. AME's certifications in this study are limited to three lean manufacturing certifications it offers in partnership with ASQ and SME.

**4.4.3.4 Association for Operations Management (APICS).** APICS is a not-for-profit international education organization, offering certification programs, training tools and networking opportunities to increase workplace performance. It was founded in 1957 as the American Production and Inventory Control Society, and currently has more



than 43,000 individual and corporate members in more than 10,000 companies worldwide. APICS is known today for its training, internationally recognized certifications, comprehensive resources, and worldwide network of accomplished industry professionals. Within the scope of this study, APICS maintains two significant professional certifications, Certified in Production and Inventory Management (CPIM) started in 1973 and Certified Supply Chain Professional (CSCP). Both are accredited by NCCRS.

**4.4.3.5 Association of Technology, Management and Applied Engineering (ATMAE).** Formerly known as the National Association of Industrial Technology (NAIT), it is a nonprofit organization that sets standards for academic program accreditation, personal certification, and professional development for educators and industry professionals involved in integrating technology, leadership and design. Its primary mission is faculty, students, and industry professionals dedicated to solving complex technological problems and developing the competitive technologist and applied engineering workforce. Three certifications are included within the scope of this study: Certified Technology Manager (CTM/CTSM), Certified Manufacturing Specialist (CMS/CSMS) and Certified Technical Professional (CTP / CSTP). All of them are relatively new; CTM dates from 1993 and the other two are 2009 and 2010, respectively. None of them are accredited and relatively few of the certification holders are from outside the United States.

**4.4.3.6 Autodesk, Inc.** A vendor-specific certification organization, Autodesk is a publicly-traded American multinational corporation that focuses on 2D and 3D design software for use in architecture, engineering and building construction, manufacturing,

and media and entertainment. Autodesk was founded in 1982 by John Walker, a coauthor of early versions of the company's flagship computer aided design (CAD) software product AutoCAD, and twelve others. Two Autodesk certifications are included within the scope of this study, neither of which is accredited or integrated into any postsecondary college curricula.

**4.4.3.7 Board of Certified Safety Professionals (BCSP).** BCSP began in 1969 as a peer certification board based on recommendations from a study performed by the American Society of Safety Engineers. Six professional organizations are affiliated with the BCSP: American Industrial Hygiene Association; American Society of Safety Engineers; Institute of Industrial Engineers; National Safety Council; Society of Fire Protection Engineers; System Safety Society. The BCSP also has an alliance with the United States' Occupational Safety and Health Administration and the Council on Certification of Health, Environmental, and Safety Technologists to collaborate on training, education, outreach, and advocacy. The BCSP is not a membership organization; its purpose is to solely certify practitioners in the safety profession. Three of its certifications are included within the scope of this study: Certified Safety Professional (CSP), Associate Safety Professional (ASP) and Graduate Safety Practitioner (GSP). Currently, 12,637 hold the CSP certification (created in 1969) and 236 are from outside the United States, or nearly two percent. All three of the certifications included within the scope of this study are accredited by ANSI. Of particular interest is the GSP certification. This is one of the few professional certifications in the study specifically designed to be integrated into postsecondary college programs. There are nearly 1,000 holders of this certification. The only eligible

candidates for the certification must have graduated from an approved baccalaureate safety program; currently there are twelve postsecondary colleges approved. While Buffalo State College has an undergraduate Safety Studies minor program within its Technology Department, it is not among the approved postsecondary programs. The GSP certification is a pathway to achieving the CSP certification.

**4.4.3.8 CNC Software, Incorporated (CNC).** A vendor-specific certification organization, CNC was founded in 1983 and is considered a pioneer in the PC-based CAD/CAM industry. CNC is an employee-owned company with 110 employees. CNC Software was one of the first companies to introduce CAD/CAM software, known as Mastercam, designed for both the machinist and the engineer, providing practical solutions to both markets. Today, there are over 150,000 installations of Mastercam. CNC has three certifications included in the scope of this study, all created in 2001. While none of these certifications are presently accredited, CNC is currently having the certifications evaluated for accreditation by NIMS. In addition, CNC also operates Mastercam University (MastercamU), an Internet-based learning system where users can practice current skills, learn new ones, or prepare for Mastercam certification. There does not appear to be any direct postsecondary college program integration with Mastercam's certifications. According to CNC, "many colleges are adopting the MastercamU online courses to enhance their training, keeping it up-to-date and more robust. College credit may be obtained through some of these schools" (CNC Software, Inc., 2011, para. 4).

**4.4.3.9 Institute of Industrial Engineers (IIE).** IIE is a nonprofit member-based professional society founded in 1948 as the American Institute of Industrial Engineers

and renamed in 1981 to reflect a growing global presence. Today, IIE is the world's largest professional international, nonprofit association that provides leadership for the application, education, training, research, and development of industrial engineering. Seven IIE certifications are included within the scope of this study. All were created in 1998 and one, the Six Sigma Black Belt Certification, is accredited by ACE. IIE has active chapters with several colleges including Southern Polytechnic State University and the University of Southern California.

**4.4.3.10 Institute for Supply Management (ISM).** A not-for-profit association founded in 1915, ISM is the world's largest supply management association. ISM's mission is to lead the supply management profession through its standards of excellence, research, promotional activities, and education. ISM's membership base includes more than 34,000 supply management professionals with a network of domestic and international affiliated associations. One certification from ISM is included within the scope of this study, Certified Professional in Supply Management (CPSM). It is not accredited or integrated into any postsecondary program.

**4.4.3.11 International Society of Automation (ISA).** A nonprofit organization founded in 1945 as the Instrument Society of America by Richard Rimbach of the Instruments Publishing Company in Pittsburgh, Pennsylvania. Today known as the International Society of Automation, it is the leading global organization that sets the standard for automation by helping over 30,000 worldwide members and other professionals solve difficult technical problems, while enhancing their leadership and personal career capabilities. ISA develops standards; certifies industry professionals; provides education and training; publishes books and technical articles; and hosts

conferences and exhibitions for automation professionals. Two ISA certifications are included within the scope of this study, the Certified Automation Professional (CAP) and the Certified Control Systems Technician Program (CCST), neither of which are accredited nor integrated into postsecondary college technology programs.

**4.4.3.12 Manufacturing Skill Standards Council (MSSC).** An industry-led standards-based, training, assessment and certification system focused on the core skills and knowledge needed by the nation's production and supply chain logistics workers. The nationwide MSSC System, based upon industry-defined and federally-endorsed national standards, offers both entry-level and incumbent workers the opportunity to demonstrate they have acquired the skills increasingly needed in the high-growth, technology-intensive jobs of the twenty-first century. Three professional certifications from MSSC are included within the scope of this study, the Certified Production Technician (CPT) and Certified Logistics Technician (CLT). While none of these certifications are accredited nor integrated into postsecondary technology programs, they are integrated into Buffalo Public Schools career and technical education curricula.

**4.4.3.13 Material Handling and Management Society (MHMS).** MHMS is a nonprofit organization that originated during the 1960s. It is the largest U.S. material handling and logistics association representing the leading providers of material handling and logistics solutions. MHMS offers professional education programs for students to stay current in industry and maintain their credentials. Two professional certifications from MHMS are included in the scope of this study, including the Professional Certified in Materials Handling (PCMH) certification. None of MHMS's certifications are accredited or integrated into postsecondary technology programs.

**4.4.3.14 Society of Manufacturing Engineers (SME).** SME is a nonprofit member-based organization founded in 1932 as the Society of Tool Engineers. A year later, the organization was renamed the American Society of Tool Engineers and in 1969 it was renamed Society of Manufacturing Engineers. The organization presently has about 21,000 members. SME offers two certifications included within the scope of this study: Certified Manufacturing Technologist (CMfgT), and Certified Manufacturing Engineering (CMfgE) Certification. In addition, SME also offers Lean Certification in conjunction with ASQ, as previously discussed. While none of these certifications are directly integrated with postsecondary programs or accredited, SME does have some additional certifications utilizing innovative partnerships with two universities. In conjunction with Arizona State University, SME offers a Six Sigma Black Belt Certification and Six Sigma Green Belt Certification. In conjunction with Purdue University, SME offers a Green Manufacturing Specialist Certificate.

Lastly, in an interesting and emerging trend, in addition to providing these certifications and associated training materials, SME now offers Internet-based training through its newly acquired Tooling U. In September 2010, SME announced they purchased all outstanding shares of Tooling U, a leading provider of online training for the manufacturing industry. SME's certifications, in-person training and webinar offerings will be combined with Tooling U's online training platform and more than 400 courses to provide the global manufacturing community with a comprehensive source of manufacturing knowledge. Barbara M. Fossum, Ph.D., FSME, president of SME said:

by 2012, it is estimated the United States alone will be short 3 million skilled workers. Acquiring Tooling U is part of a new initiative that will enable us to offer comprehensive learning and workforce development solutions to help companies combat this increasing talent shortage, and to

provide a much broader span of continuing education opportunities for member career growth (Society of Manufacturing Engineers, 2010, para. 3).

#### **4.4.4 Certifications Relevant to Electrical Engineering Technology**

**(Electronics and Smart Grid).** Six certification organizations (all vendor-neutral) representing 20 professional certifications are included within the scope of this study.

**4.4.4.1 Association of Energy Engineers (AEE).** AEE is a nonprofit professional society founded in 1977 with over 13,000 members in 81 countries. The mission of AEE is to promote the scientific and educational interests of those engaged in the energy industry and to foster action for Sustainable Development. Four certifications are included within the scope of this study.

**4.4.4.2 Electronics Technicians Association International (ETA-I).** Founded in 1978 by electronics technicians, ETA-I is a not-for-profit, worldwide membership-based professional association whose mission is to represent and support the technical professional. ETA-I aligns with individual professional goals, vocational and education curriculums, and businesses' resource initiatives through certification programs, conferences, speaking engagements, and book and journal publications. While ETA-I offers many certifications, four certification are included within the scope of this study. The Certified Electronics ETA Certification, ETA-I's entry-level certification, is integrated into Erie Community College Electrical Engineering Technology program (Erie Community College, 2008, p. 107). The certification is valid for two years and the certificant may then pursue a journeyman or senior level certification from several different areas of specialization. There is also a master level certification for individuals with at least six years' experience.

**4.4.4.3 International Association for Radio, Telecommunications and Electromagnetics, Inc. (iNARTE).** iNARTE was founded in 1982 as a non-profit organization by industry leaders to develop a comprehensive certification program for telecommunications engineers and technicians. Within the scope of this study, six certifications are included. Two of the certifications: Electromagnetic Compatibility (EMC) and Electrostatic Discharge Control (EDC) are accredited by the ICAC. In addition, iNARTE has a partnership with four universities to directly integrate their certification program into their curriculum (Southeast University, Nanjing, China; Beijing University of Posts & Telecommunications, China; Missouri State University of Science & Technology; and Clemson University, South Carolina).

Brian Lawrence, Executive Director of iNARTE, discussed the challenges that face certification organizations when they attempt to integrate their certifications with college programs. He indicated that some universities may fear an independent quality control check when he said:

Our relationship with these universities all relate to our EMC certification product. That certificate is available to engineers and technicians working in EMC fields, but requires either nine or six years of related experience respectively. Although we do encourage younger practitioners to start the certification process while gaining experience, they seem reluctant to do so. In 2009 we decided to offer an associate level certificate that could be awarded to graduates from an iNARTE accredited university if they had taken enough EMC courses for their professors to endorse them as qualified to enter the EMC field and make an immediate contribution. We attempted to get universities that offered EMC courses to apply for accreditation with us, but very few responded. Among the responders were the four universities. Although we have these four on our books, we have been disappointed that just two students from Missouri State University of Science & Technology have been awarded associate EMC certification. It seems universities are not so interested in assisting their graduates to build a career, but much more motivated to get grants and industry-sponsored research and development programs. The professors as individuals say the right things, but the system lets them down and their



spare time is spent writing papers for conferences and journals (Lawrence, 2011).

#### ***4.4.4.4 International Society of Certified Electronics Technicians (ISCET).***

ISCET is a nonprofit membership-based professional association that promotes technical certification worldwide, and provides a place for certified technicians to join forces for professional advancement. Three certifications are included within the scope of this study including its flagship certification, the Certified Electronics Technician (CET), first offered in 1965. While one of the oldest certifications within the scope of this study, none of ISCET's certifications are accredited nor integrated into postsecondary college programs.

***4.4.4.5 Institute of Electrical and Electronics Engineers (IEEE).*** IEEE is a nonprofit member-based professional association, it was originally founded in 1884 as the American Institute of Electrical Engineers. In 1963, the association merged with the Institute of Radio Engineers (formed in 1912) to create the IEEE. By 2010, IEEE had over 395,000 members in 160 countries (45 percent outside the United States). IEEE offers several certifications, one of which is included within the scope of this study (Certified Biometrics Professional). The certification is neither accredited nor integrated into postsecondary educational programs.

***4.4.4.6 National Institute for Certification in Engineering Technologies (NICET).*** A nonprofit organization established in 1961 that provides a nationally recognized and accepted procedure for recognition of qualified engineering technicians and technologists within the United States. The present organization, formed in 1981, represents the merger of two organizations: the Institute for the Certification of Engineering Technicians and the Engineering Technologist Certification Institute, formed

in 1977. NICET offers two certifications relevant to electrical engineering. One of which, the Certified Technologist, is integrated into ABET-accredited programs (BSC's Electrical Engineering program is ABET-accredited). NICET's professional certifications are somewhat atypical compared to other certifications because they are targeted only to citizens of the United States. Of their present 260 certificants, they are all U.S. citizens.

**4.4.5 Certifications Relevant to Mechanical Engineering Technology.** Six certification organizations (all vendor-neutral) representing 13 professional certifications are included within the scope of this study:

**4.4.5.1 American Design Drafting Association (ADDA).** ADDA is an international non-profit, professional membership and educational organization founded in Bartlesville, Oklahoma in 1948. The organization was conceived by a group of oil and gas industry piping drafters, educational instructors, piping designers, and engineering personnel who started the Association of Professional Draftsmen. In 1960, the association changed its name to American Institute of Design Drafting (AIDD).

In 1967, AIDD became involved in education and curricula certification for all schools that taught drafting and design programs. The program was designed to assist schools teaching design drafting to update and better prepare students to qualify them for employment in the design drafting industry. Certification is available to secondary, postsecondary, community and technical colleges, and four-year colleges and universities.

In 1989, the organization's name was changed to American Design Drafting Association (ADDA). Starting in 1994 ADDA started receiving inquiries to support

schools, colleges, and industries to train their newly hired CADD operators in the drafting and design processes. ADDA developed a new curriculum outline in conjunction with the Department of Education and the Department of Labor. It was necessary to work with engineers and architects to find the minimum and maximum qualifications they needed when working with design personnel. ADDA then developed its professional certification test presently administered all over the world. ADDA currently certifies approximately 750 persons per year.

ADDA is working with the State Departments of Education in 15 states certifying curriculum programs on individual and statewide levels. These certification programs are developed to meet the vocational and technical requirements set forth by the U.S. Department of Education and the U.S. Department of Labor. Two ADDA certifications are included within the scope of this study.

**4.4.5.2 American Society for Engineering Management (ASEM).** Founded in 1979, ASEM is a not-for-profit membership-based professional association that provides engineering management solutions to create, lead and sustain great technical organizations and promotes the development and practice of the engineering management profession. The goals of the organization are to grow and share the engineering management publications; guide and enhance engineering management educational programs; advance the careers of engineering management professionals; engage engineering management professionals and foster and recognize engineering management best practices. The organization currently has 700 members.

Upon the decision by ASME to dissolve Engineering Management Certification International (EMCI), in July 2010 ASEM agreed to develop an equivalent program to

carry forward the work of certifying engineering managers. ASEM created two certifications which are included within the scope of this study: Associate Engineering Manager (AEM) and Professional Engineering Manager (PEM). These two certifications are integrated into postsecondary technology programs on a limited basis. A requirement for certification is a Bachelor of Science postsecondary degree in an engineering or related field. However, graduates of ABET-accredited programs are exempt from the requirement of taking ten ASEM training modules that are estimated to take four hours to complete for each module. Both Buffalo State College's Mechanical and Electrical Engineering programs are ABET accredited.

**4.4.5.3 American Society of Mechanical Engineers (ASME).** ASME is a not-for-profit membership-based professional association that enables collaboration, knowledge sharing, career enrichment, and skills development across all engineering disciplines, toward a goal of helping the global engineering community develop solutions to benefit lives and livelihoods. ASME was founded in 1880 by industrialists Alexander Lyman Holley, Henry Rossiter Worthington, John Edison Sweet and Matthias N. Forney in response to numerous steam boiler pressure vessel failures. ASME has grown through the decades to include more than 120,000 members in over 150 countries worldwide. Two certifications are included within the scope of this study, both created in 1997. Of the certification holders, about 17 percent are from outside the United States. None are accredited or integrated into postsecondary technology programs.

**4.4.5.4 Council on Quality and Leadership (CQL).** Founded in 1969 as a quality advocacy organization, it became independent and non-profit in 1979. One certification

is included within the scope of this study, the Certified Quality Analyst. The certification is neither accredited nor integrated with postsecondary technology programs.

***4.4.5.5 National Institute for Certification in Engineering Technologies***

**(NICET).** NICET offers two certifications within the mechanical engineering scope. One of which, the Certified Technologist, which is integrated into ABET-accredited programs (BSC's Mechanical Engineering program is ABET-accredited). The other program is the Industrial Instrumentation Certification.

***4.4.5.6 Society of American Value Engineers (SAVE).*** SAVE International is

the premier international society devoted to the advancement and promotion of the value methodology (also called value engineering, value analysis or value management). Value methodology benefits include decreasing costs, increasing profits, improving performance and improving quality. Society members practice the value methodology in the public and private sectors for organizations in more than 35 countries. Value methodology applications span a variety of fields, including construction, product design and manufacturing, transportation, health care, government and environmental engineering. SAVE International offers member services such as education and training, publications, tools for promoting the value methodology, certification, networking and recognition. Three certifications are included within the scope of this study, none of which are accredited nor integrated into postsecondary technology programs.

**4.4.6 Certifications Relevant to Technology Education.** Because Technology

Education is licensed by the State of New York, there is only one professional, voluntary certification included within the scope of this study.

**4.4.6.1 National Board for Professional Teaching Standards (NBPTS).** One organization, the National Board for Professional Teaching Standards (NBPTS), has a certification for Career and Technical Education/Early Adolescence through Young Adulthood. NBPTS is an independent, nonprofit, nonpartisan and nongovernmental organization. NBPTS was formed in 1987 to advance the quality of teaching and learning by developing professional standards for accomplished teaching, creating a voluntary system to certify teachers who meet those standards and integrating certified teachers into educational reform efforts.

**4.4.7 Certifications Relevant to Computer Information Systems.** Compared to some of the other professional certifications within the scope of this study, Computer Information Systems relevant professional certifications are relatively new. The first professional certification was from Novell, Inc., created in the late 1980s as discussed in Chapter Two of this study. However, since that time, the sheer quantity of CIS certifications has eclipsed all other categories. There are presently hundreds of certifications held by millions of certificants. Nearly every hardware manufacturer and software vendor has a professional certification on their product as well as many vendor-neutral organizations' certifications. Because of this volume, the researcher has limited the scope to those certification organizations identified as significant through qualitative interviews defined in the second aspect of this study (value/awareness of professional certifications). The recommendations made by the subjects of qualitative interviews were corroborated by the 2010 most in-demand certification recommendations made by Robert Half Technology's staffing and recruiting professionals across the United States. Those recommendations included certifications by Cisco, Microsoft, Project Management

Institute, and ISC<sup>2</sup> (Willmer, 2010). The scope is further corroborated based on 2011 certification training by TrainSignal Inc., a popular privately held computer-based training company founded in 2002. Its most popular certification programs in 2011 were: Cisco CCNA, Microsoft MCITP Enterprise Administrator, and CompTIA A+ (Munn, 2012). Seven certifications organizations are represented within the scope of this study (three of which are vendor-specific) representing 67 professional certifications.

***4.4.7.1 Professional certification integration with Trocaire College's Computer Network Administrator program and Rochester Institute of Technology.*** One postsecondary Associate's degree computer program located within Buffalo merits study because of its focus on integration with relevant professional certifications: the Network Administrator program at Trocaire College. Buffalo State College has a transfer articulation agreement in place for several of the Trocaire classes designed for professional certification integration.

Trocaire College, located in Buffalo, New York, is currently the only degree-granting institution within Western New York that is a Microsoft's Information Technology (IT) Academy. Trocaire College is a private college, founded in 1958 by the Roman Catholic Sisters of Mercy as Sancta Maria College for women of the religious order. In 1965, admission was opened to non-religious female students. In 1967, the College's name was changed to Trocaire, the Gaelic word for mercy; appropriate since the college is located in South Buffalo, an area known for its Irish immigrant heritage. Male students were admitted to Trocaire beginning in 1972. Most of Trocaire's programs are career-centered, primarily in the nursing and health science fields, and the institution currently offers thirteen Associate degree programs, two Bachelor degree programs and

several certificate programs. Student enrollment is approximately 1,300 students. In addition to its primary campus in Buffalo, Trocaire has a second location, the Russell J. Salvatore School of Hospitality & Business, in Lancaster, New York, a suburb of Buffalo.

Trocaire offers an Associate of Applied Science (AAS) degree in Computer Network Administration (CNA), the only one of its type offered by a college in Western New York. Trocaire's original computer degree program was introduced in 1983 and the current CNA curriculum was established in 1999, based at the Lancaster campus. The CNA program classes are held in the evenings and students can pursue it on a full or part-time basis.

There are three themes that are hallmarks of the program:

1. Applied/hands-on learning;
2. Certification integration; and
3. Web sites to support certification preparation.

A fourth emerging theme is teamwork.

Mr. Jeff Frank Lesinski is the director of the CNA program. The program also has adjunct staff, including David Lee, Ph.D., who also teaches at Jamestown Community College. Mr. Lesinski holds a Bachelor's degree in electrical engineering and early in his academic education he realized theory-only study was a frustrating experience. He became convinced education must be coupled with applied, experiential learning to be effective.

As a result, when Mr. Lesinski developed the current CNA program, he based it on principles of applied learning with a strong hands-on orientation. For example,



students not only study the theory of computer networks, but they also routinely build them to practice the concepts being learned.

In addition to incorporating experiential learning principles, Mr. Lesinski has developed the CNA program to have a strong computer certification orientation. The curriculum is aligned with a range of certifications from Microsoft, Cisco and vendor-neutral organizations. In addition, Trocaire faculty encourages and assists students with developing their own personal certification strategy.

In Mr. Lesinski's description of the CNA program he stresses candidates "should be naturally curious and almost passionate about computers. CNA students need to be committed to a lifelong learning experience as this is an extremely dynamic field." Aligning the curriculum to relevant certifications is designed to make students aware of the concept of current, continual education associated with their field of study. Mr. Lesinski believes it is the program's responsibility to inform students of the impact of certifications on the information technology industry and to make students aware of relevant professional certifications.

Mr. Lesinski considers relevant professional certifications when designing the curriculum. While he does not use certification assessments to determine the grade for the student, the course curriculum is closely aligned with the material required for the associated professional certification examination(s). According to Mr. Lesinski, between 60-95 percent of certification objectives are included within the course curriculum.

Because of the changing nature of certifications, so too must the CNA program curriculum be updated. The CNA program was originally designed around the exams associated with the Microsoft Certified Systems Administrator (MCSA) certification.

However, now that the Microsoft Server 2003-based MCSA certification has been obsoleted with more specialized Microsoft certification exams, the CNA program has also been adapted. Mr. Lesinski said:

While I understand Microsoft's new certification philosophy, the specializations make it confusing to the student and challenging to create an associated technology curriculum. I've considered incorporating the new Microsoft Technology Associate (MTA) track, but I really want to give my students something valuable to industry right away, and not an academically-oriented certification like the MTA. In addition to providing certifications, being a partner of the Microsoft IT Academy/Academic Network Alliance provides our students with free copies of Microsoft networking software which otherwise they would never be able to afford. That's an important benefit to our students.

In addition to Trocaire being a Microsoft IT Academy, it is also a CompTIA Authorized Academy. As such, Trocaire receives student vouchers for CompTIA exams and the program's students qualify for reduced exam fees. Mr. Lesinski added:

While perhaps not as valued in industry, CompTIA certifications map perfectly to components of our CNA program! We also use Cisco as the basis of some of our networking curriculum, although we have not yet pursued certification-level assessment preparation because of the exams' rigor. However, it is the certification in which students express the most interest. Our CNA lab has racks of Cisco equipment specifically selected and designed to assist in CCNA (and beyond) preparation. The lab equipment and associated documentation are available for students' use to individually prepare for the CCNA exams. In addition, relationships with high school Cisco Academies (in particular BOCES) is an important part of my CNA program recruiting.

Other CNA program classes are mapped to relevant professional certifications in Table 6.

**Table 6. Trocaire CNA Courses Mapped to Relevant Certifications.**

Course	Title	Certification Mapping	BSC Articulated (Y/N)
<i>First Year - First Semester</i>			
CNA 101	Introduction to Computer Hardware	CompTIA A+ (Hardware)	N
CNA 105	Introduction to Computer Networking	CompTIA Network+ First half of Cisco CCNA	N
<i>First Year - Second Semester</i>			
CNA 112	Operating Systems	CompTIA A+ MS CTS Windows 7 Configuration	Y

Course	Title	Certification Mapping	BSC Articulated (Y/N)
CNA 115	Network Infrastructure	Second half of Cisco CCNA MS Network Infrastructure	N
<i>Second Year - First Semester</i>			
CNA 208	Linux/UNIX	CompTIA Linux+ Linux Prof. Institute Certification (level 1 and 2)	Y
CNA 210	Network Administration	Microsoft CSA CompTIA Server+	Y
CNA 266	Project Management	CompTIA Project+	Y
<i>Second Year - Second Semester</i>			
CNA 260	Advanced Network Administration	Microsoft CSA CompTIA Server+	Y
CNA 264	Computer Security	CompTIA Security +	Y

One of the reasons why certification assessments are not leveraged within the scope of the curriculum for the student's grade is due to their academic rigor and the short timeframe during each semester to cover the course material.

In response to this, at the end of each academic year or semester, Mr. Lesinski asks students if they are interested in pursuing the associated professional certification. He then will have a separate session/class focused on preparing students for the certification examination(s). These sessions are typically given during the summer and include practice tests. However, Mr. Lesinski has found in the summer, study group meetings are not practical and therefore he has recently implemented distance/computer-based learning technology for these sessions. For each certification, Mr. Lesinski creates a website and PowerPoint presentations with sample questions. According to Mr. Lesinski, one of the advantages of distance-based learning is once the program is created, it can be administered by adjunct professors. Mr. Lesinski underscored the desirability of Cisco certifications when he said:

The Cisco CCNA certification was the first of the early study groups the students selected and participated in and it was the first distance learning site developed. When everything is in place and used for the CCNA and

we begin to see results I will say the certification orientation part of the CNA program “has arrived.”

For the distance learning component focusing on certification preparation, Mr. Lesinski uses an open source software package for producing Internet-based courses and web sites called Modular Object-Oriented Dynamic Learning Environment (MOODLE). The system was created by Australian Martin Dougiamas (born 1969), who has graduate degrees in computer science and education. Dougiamas is currently using MOODLE to write a Ph.D. thesis: *The use of Open Source software to support a social constructionist epistemology of teaching and learning within Internet-based communities of reflective inquiry*.

MOODLE is global in its use and was designed to support a social constructionist pedagogy. As such, it is a digital incarnation of object-based/applied learning educational theories of Della-Vos, Runkle, Pestalozzi, Sheldon, Woodward, Piaget, and Papert as described in Chapter Two of this study.

However, MOODLE evolves these previous theories of constructivism through the Internet and distance-based learning. MOODLE also incorporates constructionism, the concept of learning being positively reinforced when constructing something for others to experience. According to MOODLE’s statistical website, as of December 2011 it had a user base of 66,169 registered sites, serving 58.5 million users in 215 countries (MOODLE, 2011).

Despite Mr. Lesinski’s efforts to integrate professional certifications into the CNA program and the use of MOODLE for exam preparation, the reality is not all students choose to pursue the program’s associated certifications. Some of the reasons why students choose not to pursue professional certifications include the cost and time

required to prepare for the exams measured against the certifications' perceived value.

Lesinski said:

Some students believe they don't need certifications, although no one questions the belief it could open some doors. There are few 'traditional' students in Trocaire's CNA program; most are currently employed and working in their field.

While we have a great program, there is always room for improvement. Increased enrollment and gender diversity are objectives I strive for; we typically have just one or two women in our program at any given time. Continued refinement of program curriculum and alignment with current relevant professional certifications is a process of continual improvement. Creation of a four-year program is my long-term goal. There simply isn't enough time in a two-year program to pack in everything that should be taught, and to further refine participation in relevant certification programs. I thoroughly believe in the value of professional certifications and would like to engage more students in the program (Lesinski, 2011).

In contrast to Trocaire is the Rochester Institute of Technology (RIT), a prestigious private university. In many ways, the school parallels the development of technology curricula at Buffalo State College. RIT traces its origin to 1829 with the founding of the Rochester Athenaeum. In 1891 the Athenaeum merged with the Rochester Mechanics Institute, founded in 1885. The Mechanics Institute provided technical training for skilled workers in industry, and its first class was mechanical drawing. By the beginning of the twentieth century, the school had five departments including: Industrial Arts; Mechanic Arts and Sciences; Manual Training; Domestic Science and Art; and the Department of Fine Arts. The school grew rapidly in the twentieth century and today has over 16,000 undergraduate and graduate students.

Dr. Charles Border is an associate professor at RIT's School of Informatics who has a thorough knowledge of both higher education and professional certifications. In addition to his position at RIT, Dr. Border started the Cisco Networking Academy at

Genesee Community College, after studying the program at Alfred University, one of the first Cisco programs in Western New York. Dr. Border is also CCNA certified.

Dr. Border commented on the challenges of integrating certifications with a baccalaureate technology program when he said:

Once a year, we convene our Industrial Advisory Board and the question always comes up about whether to integrate professional certifications into our program. This is especially relevant as we re-develop our program from a quarter basis to a semester basis by 2013. The response is always the same: "It's not an issue." Our advisors don't think it's important, and I find that surprising. The employers who are on our Advisory Board tell us if they want their employees to become certified, they will take care of that.

The underlying reason for that is because at RIT, we are focused on educating our students and not focused on job training. I consider certifications more of technology implementation or learning an interface, whereas true technology education focuses on the underlying tenants of technology. Many of my students are surprised when I advise them to purchase older editions of text books that can be obtained at a greatly reduced price. I tell them the underlying technology sometimes hasn't changed in twenty years. They seem shocked.

As an educator who has been involved in integrating a technology program with a certification program, I understand its positive and negative aspects. While there is a significant market for certifications, the downside is that the program gives its curriculum development control away to the professional certification organizations.

One example of that is what is happening now with the emergence of virtual cloud computing. It's very exciting and will be changing the face of computing over the next few years. However, much of it is Linux/open source-based. If we were held to a Microsoft curriculum compliant with its certification track, we would not be able to introduce these emerging technology trends that don't fit in with the published curriculum. Because of that, even though I think Cisco has a wonderful certification program, I have a tendency to believe vendor-neutral certifications are better to integrate with college programs if there is a desire to do so.

I believe professional certifications are better suited to a secondary school level rather than college. It's a programmed environment and satisfies high school students' need to see tangible results of their work in

a predictable way. That sort of accomplishment can often compel them to pursue a technology major at a degree-granting postsecondary institution.

After secondary school integration, I think it makes most sense to integrate professional certification programs into community colleges. Community colleges play a very important role in the U.S. educational system, but they are very different than a traditional four-year or graduate-level educational institution. Most students who attend a community college are focused on obtaining employment. For many students, they may be the first in their family to pursue an education beyond high school. In that case, certifications make sense because they not only compliment the material being taught, but also provide an additional credential to augment their Associate's degree that will be of great value when seeking employment.

At the four-year postsecondary institutional level, certifications can be used to augment the core material studied in the program and should be pursued concurrently if the student has an interest. In our labs at RIT, our freshmen and sophomore students prefer cookie-cutter lab exercises with which they can follow along. However, at a junior and senior level, our lab exercises are outcome-based, not procedural. We describe *what* we want to student to produce, not *how* to produce it. That's up to the student to determine. That's one area in which most professional certification programs fail.

We can easily teach our students about technology implementation, such as those offered through professional certification programs, and even easily teach our students the more complex underlying technology concepts. However, it is difficult to teach our students critical thinking/problem solving skills and creativity. China, a country that has some of the world's finest technology students, scours the world to find teachers to impart creativity. I believe creativity and problem solving are inherently related and are very important skills for successful technology students. While it seems some people have innate creative and problem solving talents, they are skills that can be taught, but it is difficult to do so and should be developed early in a student's college journey, and ideally even before they enter college. To be creative and solve problems, students must learn the even more basic concepts of mental flexibility and when faced with a challenge, must learn how to relax their mind in the midst of a stressful situation. It is only then creativity and effective problem solving can flourish.

RIT does have some integration with professional certifications such as those offered by the American Society for Quality. Those integrations are typically driven by business, such as Xerox and Kodak. Other desirable certifications include Six Sigma. The vendor-neutral

nature of these certifications enables them to fit more easily into RIT's curricula structure.

While Dr. Border's believes in the importance of professional certifications despite his ambivalence on their ability to be integrated into a four-year technology program, he agrees it is challenging for students to gain awareness of certifications relative to their academic studies and interests:

I suppose most students hear about professional certifications through job advertisements, head-hunters or from other students. I think it might be a good idea to introduce the concepts of professional certifications as continuing educational model, but there does not seem to be an easy way to do that within the existing educational system (Border, 2011).

**4.4.7.2 Cisco Systems, Inc.** Founded in 1984, Cisco is an American publicly traded for-profit multinational corporation that designs, manufactures, and sells consumer electronics, networking, voice, and communications technology and services. Headquartered in San Jose, California, Cisco has more than 70,714 employees and had revenue of \$40 billion in 2010. About 1993, the Cisco became involved in training with the establishment of Cisco Networking Academy to provide global training for network associates. Cisco training was established as a benchmark standard for network associates and IT technicians. Cisco was also a leader in the introduction of formal certification programs to insure the competence and skill level of networking employees. It was Cisco's belief a college education by itself was not a guarantee of a person's capacity to do a job.

Within Western New York, Erie Community College is the regional hub of the Cisco Networking Academy, integrated within the College's Telecommunications Technology program. The ECC/Cisco Networking Academy is also integrated with the



school's Information Technology/Networking Concentration Associate in Applied Science (AAS) program.

The Telecommunications Technology program, which awards its graduates with an Associate in Applied Science (AAS), has an academic concentration in digital audio, video and data transmission services. The program prepares students with the entry-level skills required to become telecommunication equipment technicians. Students study and work with specialized telecommunications equipment employing advanced transmission methods. Two thirds of the credit hours required for graduation in the program are telecommunications courses, with heavy emphasis on laboratory and hands-on experience. Specific telecommunications courses are supplemented with other coursework including mathematics, English and general education electives (Erie Community College, 2008, p. 157).

James Stranz is Erie Community College's Telecommunications Technology Department Chair and Assistant Professor as well as the Program Coordinator of the College's Cisco Networking Academy. The program's most popular certification is the Cisco Certified Network Associate (CCNA). Other Cisco significant certifications include: Cisco Certified Entry Networking Technician (CCENT), CCNA Security, and Cisco Certified Network Professional (CCNP). In addition to the Cisco certifications, ECC's Telecommunications Technology program is also integrated with CompTIA's A+ and Network+ certifications.

ECC became a Cisco Networking Academy in 2002 and since then the program has been very popular. Six of the ten courses that make up the CCNA curriculum are taught in ECC's day programs, Telecom Technology and the Verizon NextStep program

(limited to Verizon employees). Currently, there are approximately 100 day students working on one of those two degrees which are integrated with CCNA courses. The evening CCNA program has been steadily growing over the last six years, going from 20 to 30 new students per year to 125 new students in 2010-2011. It is expected the number of students will be even higher in 2011-2012. For evening students, classes are held either one evening every week, or every-other week, and are designed to work around a busy student schedule. Students Approximately 30-40 Information Technology students annually pursue the Cisco CCNA program.

Gender diversity within ECC's Cisco Networking Academy is similar to other programs previously discussed. Few women attend the program. There are almost no women in the Telecommunications Technology program and approximately ten to fifteen percent from the Information Technology/Network Concentration program.

Since the Cisco courses earn SUNY college credit, students must be assessed independently of the Cisco certification exam assessment. Students take homework assessments outside of the classroom, and a proctored final exam. Online textbooks and a Cisco lab simulator are included in the cost of tuition, although the fees associated with the Cisco required exams are not. However, students can obtain discount vouchers for the exams that reduce the cost of the exam by about 50 percent.

Stranz and other instructors in Erie Community College/Cisco Networking Academy emphasize the value of professional certifications and "absolutely" believe professional certifications are important to augment a traditional postsecondary technology degree. When commenting about certifications, Stranz said:

It shows an employer the student went that "extra mile." Also, it might give a student a competitive edge over someone with only the degree

when applying for a job. That being said, actual work experience will always be the most important factor” (Stranz, 2011).

As an illustration of the value of the introduction to technology certifications at the secondary school level and integration its programs, Aaron McClellan is an excellent example. As a student at Hamburg High School, McClellan attended the Cisco Networking Academy at Erie 1 BOCES, graduating in 2002. He continued his postsecondary education at Erie Community College’s telecommunications technology program that is also integrated with the Cisco Networking Academy. Finally, he obtained his Bachelor’s degree in Computer Information Systems at Buffalo State College and is an adjunct professor at Erie Community College. In 2011, McClellan was honored as a distinguished alumnus of Erie 1 BOCES’s program (Erie 1 BOCES honors resident, 2011, para. 1).

McClellan believes his enrollment in the program at Erie 1 BOCES and subsequent enrollment at Erie Community College was the “best career decision he has ever made.” McClellan always had a “geek inside” him and attributes his initial exposure to technology through his father’s influence, who was an engineer. McClellan had access to a computer since the time he was in eighth grade. According to McClellan:

When I was about 14 or 15, after wreaking havoc on my father’s computer, he told me to get my own, So went to garage sales, and bought anything I thought I could use. I disassembled the computer equipment so I could learn how it works. At that time, although I was interested in technology as a career, I thought I would pursue industrial or mechanical engineering because I was not interested in becoming a computer programmer.

In his junior year of high school he was not certain what career he wanted to pursue, so he studied the Cisco CCNA course at Erie 1 BOCES to determine his level of interest. He thoroughly enjoyed the program to such an extent he voluntarily remained

for a fifth year in high school (although he received college credit for his coursework on the Cisco program). To begin his studies, McClellan studied at Erie 1 BOCES five days a week for two hours each day. Because of time constraints, he was not able to take the Cisco CCNA certification assessment exams at high school, although he did take high school semester finals. Because he enjoyed and had an aptitude for his CCNA studies, McClellan decided to “stick with it” and pursue a Cisco-related path for college to complete his Cisco certification as well as pursue a postsecondary degree. To meet his requirements, McClellan considered three choices: SUNY IT, Alfred, and Erie Community College, but chose ECC because of its physical proximity. After graduating from ECC and earning a Cisco CCNA certification, McClellan was able begin his career, but instead decided to enroll in Buffalo State College’s Computer Information Systems program. McClellan said:

After graduating from ECC, I still had unanswered questions, and an urge to continue learning. I really wanted to understand how technology infrastructure could impact other aspects of the computer industry and Buffalo State had a well-rounded program that could help to answer those questions.

Despite having achieved a greater knowledge of computing at BSC, McClellan kept returning to Cisco. When McClellan graduated from BSC, he did not have active CCNA; because its three-year lifecycle had expired. Even so, McClellan listed the expired certification on his resume, in addition to other certifications he planned to pursue. “I think it really made a difference and I received responses to my resume right away.” When McClellan was called to job interviews, he quickly learned some companies valued certifications more so than others, especially computer service vendors. However, when interviewing with businesses that use technology, the perceived

need for certifications was less important. As my employer (Moog) said, “I don’t care what kind of ‘alphabet soup’ follows your title, as long as you know how to do your job.”

Even though McClellan’s current employer is ambivalent about certifications, he has not lost his own personal passion for them. With his positive experience at the secondary and postsecondary level with Cisco, McClellan feels strongly the certification programs in high school are important to help students become aware of career choices and offers them a mature, well-tested, respected and recognized study track. Student technology accomplishment at the secondary level can lead to further college-level education. At a postsecondary level, McClellan believes students should be aware of relevant certifications and where possible, existing courses should be modified to become integrated with industry-standard certifications. McClellan said:

Many of the classes I took at BSC, with very minor modifications, could be the basis for industry-standard certification assessments. There are many benefits to doing so, including students graduating from BSC would have multiple credentials. Not only would they have a Bachelor’s degree, but they would also leave Buffalo State with internationally industry-recognized credentials that would help them obtain employment after graduation. With my positive experiences, I can’t help but ask: *Why aren’t more college courses integrated with certifications?* (McClellan, 2011).

Nine Cisco certifications are included within the scope of this study. Cisco certifications are extremely popular. They are also highly integrated. Cisco partners with a broad range of education, government and nongovernment organizations, offering courses in high schools, community colleges, universities and non-traditional settings. One popular certification, Cisco Certified Network Associate (CCNA) (with over 100,000 certificants) is also accredited by ACE if preparatory classes are taken through SkillSoft.

**4.4.7.3 Computing Technology Industry Association (CompTIA).** A non-profit trade association, CompTIA was founded in 1982 as the Association of Better Computer Dealers, Inc. by representatives of five microcomputer dealerships. The organization later changed its name to the Computing Technology Industry Association to reflect its evolving role in the computer industry and in the U.S. business landscape at large. CompTIA is now known worldwide as the leading provider of vendor-neutral Information Technology certifications and has a global presence, serving members from offices in Australia, Canada, China, Germany, India, Japan, South Africa, South Korea, the United Kingdom, and the United States.

CompTIA certifications are enormously popular. It is estimated its first certification, A+ (created in 1993), has over 700,000 certification holders. Most of its other certifications were created since 2000. CompTIA's certifications also have global appeal and many of its certification holders are from outside the United States.

Four of the 16 CompTIA certifications included in the Computer Information Systems scope of this study (A+, Network+, Security+, and Advanced Security Practitioner) are accredited through ANSI. Three of them are also accredited by ACE if preparatory courses are taken through SkillSoft or Learning Tree. In addition to these accreditations, CompTIA is directly integrated with educational institutions. The CompTIA Authorized Partner Program for Academy Partners is an educational program designed to assist academic institutions, nonprofit organizations, and government retraining agencies to prepare students for a career in computers. CompTIA works with more than 4,000 secondary schools, postsecondary schools, not-for-profit educational institutions, and government-funded educational agencies in the United States.

As previously discussed, Trocaire College is a CompTIA Authorized Academy. In addition, Erie Community College is as well. The College offers A+ and Network+ certifications which are even more popular than their Cisco certification classes “because the classes are easier and more practical.” James Stranz, Erie Community College’s Telecommunications Technology Department Chair, said:

Vendor-neutral certifications, like those offered by CompTIA, are a good place to start, since they are usually easier, giving the student a chance to build their confidence. Vendor-specific certifications hold more value if they are with associated with large companies like Microsoft, Cisco, or Adobe, to name a few. However, vendor-specific certifications are sometimes more difficult to obtain (Stranz, 2011).

CompTIA also operates a nonprofit subsidiary, Creating IT Futures Foundation (formerly CompTIA Educational Foundation), created in 1998 to help at-risk individuals and populations under-represented in Information Technology prepare for, secure and be successful in Information Technology careers.

**4.4.7.4 International Information Systems Security Certification Consortium, Inc. (ISC<sup>2</sup>).** A global, not-for-profit leader in educating and certifying information security professionals. Headquartered in the Palm Harbor, Florida, ISC<sup>2</sup> was founded in 1989 and today has over 63,000 certified members in 138 countries with offices in London, Hong Kong and Tokyo.

Seven certifications are included within the scope of this study. Its flagship certification, the Certified Information Systems Security Professional (CISSP), has over 73,000 certificants. Its certifications are accredited by ANSI, significant because several Department of Defense jobs require an ANSI-certified security-related professional certification as a requirement for employment.

**4.4.7.5 APM Group (APMG).** APMG is a privately held organization responsible for curriculum development and certification of Information Technology Infrastructure Library (ITIL), a set of concepts and practices for Information Technology services management, Information Technology development, and IT operations. APMG is based in High Wycombe, England, with other offices located in the Netherlands, Germany, Denmark, France, India, Malaysia, China, and Australia. APMG-US is the United States division of APMG-International, a global examination institute.

First developed in 1989 by the United Kingdom's Office of Government Commerce's (OGC) Central Computer and Telecommunications Agency, ITIL originated as a collection of books, each covering a specific best practice within Information Technology service management. ITIL was built around a process-model based view of controlling and managing operations often credited to W. Edwards Deming and his plan-do-check-act (PDCA) cycle.

The ITIL Certification Management Board (ICMB) manages ITIL certification. Members of ICMB include representatives from OGC, APMG, the Stationery Office, V3 Examination Panel, Examination Institutes, and the IT Service Management Forum International.

Since the early 1990s, the OGC has given rights to EXIN International and the Information Systems Examination Board (ISEB), a part of the British Computer Society (BCS) to create the ITIL certification program and develop ITIL exams at five different levels: Foundation, Intermediate, Managing Across Lifecycles, Expert, and Master. EXIN and BCS/ISEB are the only two examination providers in the world to develop



formally acknowledged ITIL certifications, provide ITIL exams, and accredit ITIL training providers worldwide.

On July 20, 2006, OGC contracted with APMG to become its commercial partner for ITIL accreditation from January 1, 2007. APMG signed a contract with EXIN and BCS/ISEB to allow them to provide ITIL exams and to accredit ITIL training organizations. ITIL certifications are enormously popular internationally. Thirteen certifications are included within the scope of this study.

The ITIL education/certification model closely follows the model initially established by Novell as detailed in Chapter Two of this study. ICMB is responsible for overall ITIL standards and APMG is responsible for curriculum and certification development. Official curriculum must be administered to students by an ITIL-accredited training organization (ATO). Exams are then administered by authorized Examination Institutes (EI). Because of this, the organization maintains control over the quality of the courses offered. The ITIL certifications are all accredited by ACE if preparatory classes are taken through Learning Tree International, Inc. Learning Tree is a publicly-traded for-profit U.S. training company founded in 1974 and based in Reston, Virginia. Learning Tree provides over 235 courses presented globally at Learning Tree Education Centers, on site at client facilities, and computer-based Internet via Learning Tree AnyWare, the Company's proprietary live, online instructor-led training delivery option. In fiscal year 2010, revenues were \$127.5 million, and net income was \$4.4 million. In its first quarter of fiscal year 2011, Learning Tree reported revenues of \$35.6 million.

The relationship between APMG and Learning Tree is complex. APMG performs an assessment and ensures their materials match the ITIL syllabus. APMG also verifies their trainers have the required number of ITIL credits, a command of the subject matter, and acceptable teaching skills. Finally, APMG validates Learning Tree has a set of business processes suitable for handling students and course materials. Once approved by APMG, Learning Tree offers ITIL training to their students. APMG sells the ITIL certification exams to Learning Tree, who administers them to students. The exams are then returned to APMG for scoring, and APMG issues certificates to those students who pass the exams.

**4.4.7.6 Linux Professional Institute (LPI).** A non-profit organization based in in New Brunswick, Canada, LPI was founded by Dan York, Evan Leibovitch, Tom Peters, Chuck Mead, Scott Murray, and others in 1999. Besides its Ontario-based office, it also operates a U.S. office in Sacramento, California with global affiliates.

Three certifications are included within the scope of this study. LPI's entry-level certification is integrated with CompTIA Linux+ certification and Novell Certified Linux Administrator (CLA) certification. CompTIA and LPI standardized their entry-level Linux certification programs on LPI's Level One certification exams (LPIC-1) (CompTIA, 2010, para. 2).

LPIC-1 is accredited by NCCA and is integrated with at least one community college, Cuesta, located in California which has integrated the LPIC-1/Linux+ certification into their CIS 222 class. According to Cuesta Greg Porter, "One way to know what's important about an operating system, especially one used in business, is to look at the certification exams available for it. This class will introduce Unix and Linux

from the angle of preparing you for the CompTIA Linux+ certification” (Porter, 2010, para. 1).

**4.4.7.7 Microsoft Corporation (MS).** An American publicly-traded multinational for-profit corporation founded in 1975 by Bill Gates and Paul Allen, MS is headquartered in Redmond, Washington. The company develops, manufactures, licenses, and supports a wide range of computer software products and services. MS has approximately 89,000 employees and revenue in 2010 was \$62.5 billion.

As a vendor-specific certification organization, Microsoft’s certifications are among the computer sector’s most popular and its certification program is considered a leader in its field. Microsoft began its certification program in March 1992 and in 2012 the program celebrated its twentieth anniversary. According to Microsoft, seven million people have earned a MS certification since its program began (Microsoft Corporation, 2012, para. 1).

Microsoft’s certifications change regularly. In 2007-2008 its flagship Microsoft Certified Server Engineer (MCSCE) program was replaced with a more specialized Microsoft Certified IT Professional (MCITP) certification which allows students to focus on particular areas of technology. The MCITP specializations require multiple exams, the number of which depends on the area of specialization. For example, the MCITP Windows Server 2008 administrator certification requires three exams whereas the MCITP Enterprise administrator certification requires five exams. Interestingly, one of the reasons for the name change of the certification to “professional” from “engineer” is due to controversy over the term engineer, similar to the battles fought by Novell during the 1990s. Whereas Novell had states who complained about the use of the term engineer

in its certifications, some countries outside of the United States have strict rules concerning the use of the term engineer. Microsoft's change reflects the global nature of its certification program (Lieberman, Cravens, & Wall, 2011).

After a four-year absence of its MCSE program, Microsoft brought back its famed initialism, although the certification itself changed. In April 2012 Microsoft announced the new certification, Microsoft Certified Solutions Expert. Microsoft's other popular phased-out certification, Microsoft Certified Systems Administrator (MCSA), was also brought back, in initials only. The new certification, announced in April 2012, is the Microsoft Certified Solutions Associate, a pre-requisite for the new MCSE certification.

Another change Microsoft has made in its certification program is the phase out of its use of adaptive testing while at the same time its exams were changed to be more rigorous. MS found its certification candidates felt short-changed with the short length of the exam and perhaps more importantly, the adaptive exams are extremely expensive to build.

Fourteen MS certifications are included within the scope of this study. Nine of those certifications are accredited. Several are also directly integrated into secondary and postsecondary institutions through the Microsoft IT Academy, a subscription-based membership organization that offers Information Technology training and resources to schools. The program was started in 2006 and is has grown 30 percent annually. The goals of Microsoft IT Academy include workforce development, stimulating interest in technology and positively impacting economic development. Microsoft IT Academy schools offer its new certification series, the Microsoft Technology Associate (MTA). Only Microsoft IT Academy schools can offer the associated certification assessment

exams required for certification attainment. In 2012, MTA courses began and their associated exams began to be offered by computer-based training companies such as TrainSignal.

The Microsoft IT Academy Program has two membership levels: Essential and Advanced. The Essential membership is for institutions that teach Microsoft Office and Microsoft Dynamics courses, while its Advanced membership is for institutions that teach IT professional and developer courses for Microsoft certification. Advanced-level members enjoy all the benefits of the Essential level, in addition to those included with Advanced-level membership.

The Microsoft IT Academy is integrated at both the secondary and postsecondary level. In November 2010 the state of North Carolina announced beginning in the 2010-2011 school year the state will adopt Microsoft IT Academy in all its high schools, a first in the United States. A pilot program was launched in the fall 2010 and included 42 teachers and 37 schools in the state. The total scope, once fully implemented, will reach 2,500 teachers and nearly 200,000 students over the course of three years.

The Microsoft IT Academy is also integrated into postsecondary institutions. Among its most notable integrations include the Ogeechee Technical College in Georgia, a two-year technical college. Its Computer Information Systems (CIS) program is fully integrated into Microsoft's IT Academy. Certifications integrated directly into the program include MCP, MCSA and also include some CompTIA certifications such as A+, Network+, and Security+. The Microsoft IT Academy is becoming more integrated into postsecondary institutions. In 2011, the program was integrated into the University of Georgia at Athens.

Microsoft IT Academy is integrated into the SUNY Advanced Technology Training and Information Network (ATTAIN) program. Within Buffalo, there are two ATTAIN labs: the Arthur O. Eve computer lab (24 workstations) located in the Martha Mitchell Center within the Kenfield Langfield public housing at 175 Oakmont Avenue and the Buffalo Educational Opportunity Center at 465 Washington Street (approximately 30 workstations). Both of the Buffalo ATTAIN labs are designed as Microsoft IT Academy Advanced labs.

Former Buffalo-based New York State Assemblyman Arthur O. Eve, for whom the ATTAIN computer lab at Kenfield Langfield is named, has long been associated with Buffalo State College. In 1967, Eve successfully expanded a NYC-based program called Search for Education, Elevation and Knowledge (SEEK), designed to meet the needs of students who were considered to be economically disadvantaged and academically under-prepared to Buffalo State College. In 2002, the Kenfield-Langfield ATTAIN lab was named in Eve's honor due to his long years of educational support in the New York State assembly.

Cheryl Scheff, the Arthur Eve ATTAIN lab manager, notes most of the certifications given at the Eve lab are Microsoft Office-based. Anyone can take the certification, there are no income or other restrictions. As a pre-requirement, most students take the Microsoft Digital Literacy class designed to teach and assess basic computer concepts and skills. The Eve lab administers about 50 Office certifications each year, primarily in Microsoft Word. However, there is no cap on the number of certifications, and according to Scheff, "the more the better." The lab is currently a Certiport-certified test center. According to Scheff, most of the students studying

through the program in their 30s or 40s, most are unemployed or displaced college graduates, but may not have a technology background. The lab also works with the Lake Shore Lighthouse program, a residential substance abuse treatment facility for pregnant and parenting women and their children. In addition to intensive substance abuse treatment and rehabilitation, the program provides parenting, recreational, and vocational services. Scheff sees the Microsoft IT Academy as a great gift that can be used by students to better their lives through education and knowledge (Scheff, 2011).

Mike Williams is an Instructional Technology Coordinator at both the ATTAIN Eve lab and the larger ATTAIN at the Educational Opportunity Center (EOC) on Washington Street. At the EOC lab, the MTA certifications are taught. Like the Eve lab, the EOC lab is open to everyone. At both the EOC and Eve labs, the Microsoft IT Academy has been a partner for at least four years, but it has been aggressively pursued over the last two years. The MTA certification was introduced at EOC in November 2010 with an initial student population of twelve. The EOC lab is currently certified as a Certiport testing center, but Williams hoped to obtain Prometric certification for more advanced certifications. In addition, it is hoped to create a hands-on lab for the certification training that requires a hands-on lab component. Williams, who has also taught Cisco certifications, acknowledged Microsoft is maturing, compared to the Cisco certification program. "Microsoft still needs to build its community of students, teachers and alumni who help to contribute to make its programs more effective" (Williams, 2011). The Microsoft IT Academy is a global phenomenon. As of June 2011, there are over 3,600 institutions who are Microsoft IT Academy subscribers. The distribution is shown in Table 7.

**Table 7. Global distribution of Microsoft IT Academies.**

<b>Country</b>	<b>IT Academy Institutions</b>
U.S.	1431
India	839
Australia	359
China	223
Canada	166
Japan	125
Brazil	106
Mexico	75
Malaysia	52
Columbia	33
New Zealand	31
South Korea	28
Indonesia	22
Philippines	22
Puerto Rico	13
Singapore	13
Viet Nam	9
Hong Kong	8
Chile	7
Argentina	6
Bolivia	6
Peru	6
Honduras	4
Panama	4
Taiwan	4
Costa Rica	3
Ecuador	3
Guatemala	3
Sri Lanka	3
El Salvador	2
Fiji	2
Trinidad & Tobago	2
Bahamas	1
Bangladesh	1
Cambodia	1
Cayman Islands	1
Dominican Republic	1
Guam	1
Haiti	1
Lao People's Democratic Republic	1
Papua New Guinea	1
Paraguay	1
Samoa	1
Tonga	1
Uruguay	1
Venezuela	1



The Microsoft Technology Associate (MTA) certification, created in 2010, was designed specifically to integrate into secondary and postsecondary educational institutions. The certification program has been successful and as of January 2012, over 100,000 certification exams have been administered (Hansen D. , 2012). Unlike more advanced Microsoft certifications, the MTA targets students with no prior computer information technology or development experience or employment. It is available exclusively to educational institutions and is designed to easily integrate into the curricula of existing computer classes. MTA exams are only available at academic institutions that have purchased an MTA Campus License or MTA vouchers. Within the MTA umbrella, there are various specific exams as detailed below:

- Developer exams
  - Software Development Fundamentals
  - Windows Development Fundamentals
  - Web Development Fundamentals
  - Database Administration Fundamentals
- IT professional exams
  - Networking Fundamentals
  - Security Fundamentals
  - Windows Server Administration Fundamentals

The MTA program is also notable because costs for the exam are usually included within the cost of the program itself. In June 2011 at the annual Microsoft TechEd conference, a session entitled *Embedding IT Certifications into Degree Programs* was held. At that session, one postsecondary educator stated at his college, for courses with an associated certification exam, there are two sections offered. One of the course sections has a higher fee and includes a test voucher. The benefit to the student is if they

are receiving financial aid, the financial aid system will pick up the cost of the test voucher.

**4.4.7.8 Novell, Inc.** Novell is an American-based multinational software and services company, now a wholly owned subsidiary of The Attachmate Group. Formerly, it was a publicly-traded corporation. The company was founded in 1979 in Provo, Utah as Novell Data Systems Inc., a hardware manufacturer. In 1983, the company's name was shortened to Novell, Inc., the same year the company introduced its most significant product, the multi-platform network operating system, Novell NetWare. Throughout the first decade of the twenty-first century, Novell lost extensive market share to Microsoft. Today, Novell currently specializes in enterprise operating systems, such as SUSE Linux Enterprise and Novell NetWare; identity, security, and systems management solutions; and collaboration solutions. In 2009, Novell's revenue was \$862.18 million and it had 3,600 employees. In November 2010 Novell announced it had agreed to be acquired by Attachmate, a privately-held company, for \$2.2 billion; the acquisition was closed in April 2011.

Five certifications are included within the scope of this study. Novell created the information technology certification environment. Only one of its certifications within scope are currently accredited, the entry level Linux certification, Novell Certified Linux Administrator (CLA), which is shared with the A+ and LPI entry-level certifications.

## **4.5 Summary**

The data gathered focused on the three aspects of the research problem, namely technology program enrollment, certification value/awareness, and certification

mapping/integration. The following subsections will summarize the data collected within the scope of the three aspects of the problem.

**4.5.1 Enrollment.** The data collected shows nationally, enrollment in technology programs has declined. These national trending declines were echoed in a decline of an attendant number of students in several of the Buffalo State College technology programs included within the scope of this study, most notably industrial technology and computer information systems; even while overall BSC enrollment continues to grow. Indeed, the decline of enrollment in some of technology areas was alarming. Of the six programs included in this study, Computer Information Systems and Industrial Technology had declines in enrollment of approximately 50 percent since the start of 2000. Only BSC's Mechanical Engineering program has seen a modest increase in enrollments.

While enrollment is flat or had experienced declines in the last decade, the person who inspires students to study technology appears to distill to one individual. Most survey respondents and those interviewed for this study indicated they were influenced in their career and academic field of study based on the influence of a parent or teacher.

While technology enrollment was down, women college enrollment was up. Examples of individuals' data collected in the scope of this study reveals women were very capable in technology, but were not pursuing technology programs.

While there may several reasons for decline in enrollment at Buffalo State College's technology that mirror national trends, it is possible the same Internet-based technology that has provided competition may benefit Buffalo State's programs. Buffalo State's programs have a rich history with excellent faculty. If it was possible to extend

the students beyond this regional area which has suffered a loss of the jobs, it may be able to attract students to the program from outside the region.

**4.5.2 Value/awareness.** The data collected from qualitative and quantitative sources indicated there was value in certifications and a desire for greater awareness for postsecondary college students of technology programs. Data from the various data collection activities indicated although the nature and definition of professional certification was a voluntary activity, increasingly, there were jobs that require certain certifications. Most notably, the Department of Defense requires some jobs to have an ANSI-accredited security certification credential.

**4.5.3 Certification relevancy and integration.** Several aspects of the data collected were worth noting. As detailed in Chapter Two of this study, Technology Education, at Buffalo State College and nationally, evolved from Manual Training to Technology Education to the various technology programs of today (although there were early postsecondary colleges such as MIT and Cornell that offered engineering programs). Professional certifications, which have been in existence for quite some time, started to have relevancy to the scope of postsecondary college technology programs at about the same time the programs themselves started to evolve beyond Technology Education/Industrial Arts in the late 1960s. Within the scope of this study, the three earliest certifications were introduced in 1948, 1968, and 1969. However, the vast majority of them were created within the last 10-15 years, concurrent with the rise of the Internet and globalization.

Indeed, as noted previously in Chapter Two, professional certifications offered the ability to homogenize various regional postsecondary college technology curriculums as

well as offering global recognition of a particular skill. As was learned from the data, many of the certification holders were from outside the United States and many professional certification organizations tout their international memberships, even as the vast majority was headquartered in the United States. For many American companies that grant certifications (a large percentage of their certification holders were international), they cross boundaries and form a global, virtual community. There were a few notable exceptions to this, as a few professional certification organizations limit their certificants to residents of the United States, primarily in the manufacturing sector (perhaps in response to the perception of globalization being responsible for the loss of American manufacturing jobs).

Another intriguing aspect of the data collection was the growth of Internet-based distance learning classes to support professional certifications. Five organizations: Mastercam U, Tooling U, Cisco Networking Academy, Learning Tree International and SkillSoft all had distance-based Internet learning classes to support their certifications.

Closely related to this were certification assessment examinations. The trend was towards computer-based testing using either Pearson Virtual University Enterprises (VUE) or Thomson Prometric testing centers. In addition, several professional certification organizations, including Cisco and Microsoft, were leading the way with adaptive, practicum, or performance-based testing. However, Microsoft has specifically stopped creating adaptive exams for its certifications, citing high development costs.

Other interesting data were collected on accreditation and integration. There were a surprising number of certifications integrated into/or accredited for postsecondary colleges. While the scope of this study focused on those certifications relevant to Buffalo

State College's technology programs and their integration/accreditation, all data that showed any postsecondary integration and/or accreditation was collected. This was to show the growing trend of accreditation/integration and also because, theoretically, if a student attended a school and received college credit for a professional certification class, those credits could be transferred to Buffalo State College programs. When evaluating the accreditation data, such as the American Council on Education (ACE), each certification typically was worth approximately three-credit hours of undergraduate classwork. Therefore, a professional certification, while never intended to replace a postsecondary college education, can integrate with it or augment it. There are concrete examples of that throughout the data that was collected.

**4.5.4 Matrix of Data Analysis.** The relationship between the aspects of the problem and its supporting research questions to participant categories, method used to report results, and results is summarized in Table 8.

Chapter Four of this study presented data collected as it related to the three aspects of the problem the results of interviews, surveys, and enrollment data collected from relevant educational institutions.

Chapter Five contains the summarized data and implications for recommended changes as related to the three aspects of the problem: postsecondary college technology program enrollment; professional certification value and awareness; and the integration of professional certifications into secondary and postsecondary college technology programs.

Table 8. Matrix of Data Analysis.

Problem Aspect		Supporting Research Question	Participant Categories	Results Reported Method	Results
College technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery	1	How do school and program enrollments compare?	BSC and community colleges with articulation agreements	Graphs and table	Section 4.2: Figures 26-35 and Appendix Four: Except for ME, enrollment in BSC's technology programs had declined; CIS and IT declined about 50% since 2000.
	2	What influences student choice of technology program?	Technology alumni and faculty	Narrative excerpts	Section 4.2.1: Most survey respondents and those interviewed indicated they were inspired to study technology through the influence of a parent or teacher.
	3	How can recruitment methods be improved?	Technology alumni and faculty	Narrative excerpts	Section 4.2.1: Survey respondents and those interviewed suggested outreach utilizing BSC alumni to high school students, especially women and minorities.
	4	Are online classes as effective as traditional classes?	Technology alumni and faculty	Narrative excerpts	Section 4.2.1: Just 13% of survey respondents believed the quality of online classes was the same as traditional classes.
Perceptions of student/employer value and awareness of professional certifications	5	Should colleges make students aware of certifications?	Technology alumni and faculty	Table and narrative excerpts	Section 4.3.2: 100% of survey respondents believed there should be a mechanism to make college students aware of relevant professional certifications. 53% had certifications in their field.
	6	What are certifications value to students and employers?	Technology alumni, faculty, hiring managers, and industry leaders	Narrative excerpts	Section 4.3.1: All those interviewed indicated certifications had value, although value was not equal. 80% of survey respondents indicated certifications had value.
	7	Do certifications replace or augment college degrees?	Technology alumni, faculty, hiring managers, and industry leaders	Narrative excerpts	Section 4.3.1: 80% of survey respondents said certifications were important to augment a postsecondary college degree but could not replace a degree.
Relevancy and integration of professional certifications into postsecondary college technology programs	8	What certifications are relevant to scope of study?	Relevant certification organizations	Chart, table and narrative	Section 4.4, Figure 37 and Appendix Five: 36 certification organizations and 166 certifications identified.
	9	How are relevant certifications integrated with technology programs?	Relevant certification organizations and technology faculty	Chart, table and narrative excerpts	Section 4.4, Figure 38, and Appendix Five: 80 certifications were accredited or integrated. Microsoft, Cisco, and CompTIA had extensive direct secondary and postsecondary integration.
	10	Should certifications be integrated with technology programs?	Technology alumni and faculty	Narrative excerpts	Section 4.4: All survey respondents and those interviewed believed certifications should be integrated with postsecondary college technology programs.

## **Chapter Five: Discussion**

### **5.1 Introduction**

Professional certifications, a voluntary credential, were a relatively new aspect of technology education. While few professional certification programs were created in the 1960s or earlier, the vast majority of them dated from the late 1980s to the period this study was conducted; the greatest number of them were created since the start of the twenty-first century. While professional certifications were relatively new, they were enormously popular and had global appeal. There were certifications relevant to many types of professional fields, but they were particularly suited to technology fields because of the need for continuous learning due to technology's limited lifecycle.

Because of the importance of technology professional certifications and their relative newness as an educational method, this study was undertaken to correlate professional certifications to baccalaureate postsecondary technology programs and measure their perceptions. This study's problem statement was: students of baccalaureate technology programs within the scope of this study need to understand whether professional certification credentials are important for employment after graduation; what is the impact of postsecondary college technology program enrollment trends; the value and need for awareness of professional certifications; and which professional certifications are relevant and academically integrated into their field of study.

Using Buffalo State College as a representative United States baccalaureate technology degree-granting educational institution, this study addressed the problem statement by answering this research question: What professional certifications are



relevant to Buffalo State College's technology programs within the scope of this study; and to what degree will graduates of technology programs be expected to augment their education with these relevant professional certifications? Chapter One of this study introduced the problem and background; Chapter Two traced the evolution of the postsecondary technology programs at Buffalo State College, as a nationally representative baccalaureate degree-granting educational institution, as well as the origin of contemporary professional certifications. Of equal merit, Chapter Two also presented relevant extant studies of problems similar to those addressed within the current study and synthesized existing literature. Chapter Three presented the methods used to research this study's problem aspects while Chapter Four presented the results of the data gathered. Chapter Five contained discussion of the summarized data and recommended changes.

There are several reasons why this study was relevant. While the need increased within the United States for technology jobs, postsecondary Science, Technology, Engineering, and Mathematics (STEM) program college enrollment was flat or decreased. STEM programs were not as popular when compared to social science and non-STEM programs.

Another reason for the need of this study was the impact of retirees on the U.S. job market during the next twenty years. Within the next decade a mass retirement of baby boomers, expected to deplete the ranks of U.S. technical staffs, was anticipated. As a result of the smaller population of college graduates with technology degrees, a shortage of trained replacements was expected. The shortage of technology professionals impacted by the baby boomer retirement was expected to be acutely felt within those job

sectors with long tenures, such as the government sector (Marsan, *Jumping Ship*, 2012, pp. 24, 26).

There were also indications the changing world economy would reinforce the need for technology education to support organic economic growth in the United States (especially in the manufacturing and information technology sectors). As reported in Chapter One of this study, U.S. manufacturing employment peaked in 1979 with 19.5 million workers and then declined. It reached a new low of 11.7 million workers in 2011. Since then, it appeared the loss of U.S. manufacturing jobs bottomed in 2011, as 287,000 jobs were added to the manufacturing sector in 2011 and 2012. Changing world economic factors made American manufacturing more attractive than it had been in years. These factors included: higher production costs in China; flat wage growth in the U.S.; historically low interest borrowing rates; weakened dollar against competitors' currency in emerging global economies; and a boom in U.S. natural gas production (Hall, 2012, p. B5).

Because of the continued need for technology positions in the U.S. economy while at the same time postsecondary college technology enrollment experienced a decline, this study clarified the role of professional certifications in postsecondary college technology education. The study focused on three aspects of the problem: 1.) program enrollment assessment; 2.) perceptions of professional certification value/awareness by students and employers; and 3.) relevancy/integration of professional certifications into postsecondary college technology programs.

To limit the scope of the study, an assessment of technology programs at Buffalo State College and their associated relevant professional certifications was undertaken.

Specifically these six undergraduate degree programs were included within scope:

1. Computer Information Systems, B.S.
2. Electrical Engineering Technology: Electronics, B.S.
3. Electrical Engineering Technology: Smart Grid, B.S.
4. Industrial Technology, B.S.
5. Mechanical Engineering Technology, B.S.
6. Technology Education, B.S.

These areas of study were typical of four-year undergraduate technology programs at similar educational institutions throughout the United States.

## **5.2 Discussion**

This study addressed the relationship between postsecondary college technology programs and professional certifications. While existing literature about certifications revealed perceptions of the two as being very different avenues of technology education, results of this study found they had more similarities than differences. Both were highly structured educational programs with formalized curricula, instructional materials, curriculum delivery channels, and examination assessment methods. Both offered credentials to the student who successfully completed program studies and their associated assessments. The similarities, however, ended there. Most certification programs were of much shorter study duration than a baccalaureate degree program. At the same time, some advanced certification programs were of similar length to a two-year community college program. Also different was the duration of the credential validity. Postsecondary college degrees were point-in-time achievements and never expired. The vast majority of professional certifications were valid only for a specific period of time;

typically three years. Certifications' limited duration was designed to demonstrate current technology knowledge in a field where lifecycles were short. A final difference was scope. While baccalaureate degree programs imparted generalized knowledge (so-called soft-skills), certifications were very specialized, and covered specialized technology education within their scope. The rapid growth of certifications appeared to change employer expectations of job candidates. Since certifications became a component in the array of technology educational options, employers sought candidates with specific technical knowledge, generalized knowledge, as well as experience when they hired new technology employees. Lily Mok, research vice president at Gartner, Inc., an information technology research and advisory firm, described the skills that technology hiring managers sought most in 2012. She said: "It's not just about IT staff skills . . . but it's about the overall long-term ability of [technology employees] to deliver the service and the quality of the service that the business needs" (Marsan, *Jumping Ship*, 2012, p. 26).

The assertion employers sought candidates with technical knowledge, general business skills, and liberal arts education was echoed by Debra Humphrey with the Association of American Colleges and Universities. The organization acted as an intermediary between colleges and businesses to ensure graduates were prepared to meet the demands of a rapidly changing workplace. Humphrey said: "we're hearing from employers over and over again . . . students really need a combination of broad skills and abilities that you get from a really good college education." While specific technical skills remained of great importance, students who complimented technical skills with a

liberal arts education as part of a four-year program were the most desirable candidates for employment (Masters, 2012).

Despite dramatically changing economic conditions within the late twentieth century and early twenty-first century, the baccalaureate postsecondary degree remained steadfast as the hallmark of the required credential for entry into professions, which included technology positions. The importance of community colleges rose during the late twentieth century and early twenty-first century. Community colleges provided an invaluable service as it gave unrestricted access to those seeking a degree-granting postsecondary education. While often focused on job preparation courses, community colleges began the process of general education for students and may have inspired them to pursue a baccalaureate, or higher, degrees after graduation. Many four-year educational institutions, including Buffalo State College, recognized this achievement by offering liberal college credit transfers from community colleges. This was especially relevant to technology programs at Buffalo State College. Several of them were specifically designed to be “2+2” programs with highly integrated articulation agreements. A 2+2 program represented the equation of two years of community college, plus two years of a four-year college, equaled a Bachelor’s degree. Graduates of two-year college technology programs had demonstrated an aptitude and dedication to the subject area, thereby assuring a higher program retention and graduation rate as students entered the associated four-year program.

Because of the high level of professional certifications’ integration with community college technology programs and their articulation with baccalaureate technology programs, the conclusion this study reached was certifications did augment

two or four-year postsecondary technology programs. At the same time, certifications were an important (and in some cases, necessary) augmentation to Associate's and Bachelor's degrees, although certifications could never replace them.

Despite the attempt of this study, the value of professional certifications could never be fully defined due to the subjective nature of values. Research based on extant studies in Chapter Two and data gathered during the course of the present study presented in Chapter Four, suggested certifications had value. While there were varying degrees of certifications' value, the most commonly perceived value was a credential to validate skills important to employers. Just as not all postsecondary degrees were of equal value, so too was it with professional certifications, especially when coupled with field experience. Technology hiring managers preferred candidates with experience, not just certifications. However, when all other factors remained comparable, certification was often the tiebreaker when hiring decisions were made. Therefore, certifications were viewed as an important augmentation to postsecondary degrees. David Hansen, director of Microsoft product operations at Certiport, expressed this idea succinctly when he stated: "jobs are out there, right now, but they require *specific levels of expertise*. Simply because a student graduates from college with a computer science degree or with another valuable degree, this does not mean they are employable" (Hansen D. , 2012, p. 6).

The research contained in this study focused on three aspects related to the problem statement and research question. The data collected from the three aspects are discussed in the following three subsections focused on the associated aspects of the problem statement.

**5.2.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** Because of the interrelationship between postsecondary degree-granting technology programs and professional certifications, the researcher evaluated enrollment and graduation trends. Students who pursued postsecondary technology programs were likely to be candidates for the pursuit of professional certifications.

Nationally, postsecondary college technology program enrollments declined even while significant numbers of baby boomers retired. In addition, some sectors of the U.S. economy (such as manufacturing), experienced modest growth and were poised for even greater growth due to changing world economic conditions.

The national data collected showed enrollment declined in technology programs. These national declines were echoed in a local decline of an attendant number of students in several of BSC's technology programs included within the scope of this study. Most notably Industrial Technology and Computer Information Systems, experienced large declines, even as overall Buffalo State College enrollment grew. Computer Information Systems and Industrial Technology experienced a decline in enrollment of approximately 50 percent since 2000 (although the Computer Information Systems enrollment decline has stagnated since 2008). Of the other programs included within the scope of this study, only Buffalo State College's Mechanical Engineering program experienced a modest gain in enrollment.

Federal and state politicians drew attention to the national decline in secondary and postsecondary Science, Technology, Engineering, and Mathematics (STEM) program college enrollments, primarily to serve as a catalyst for the United States' global

economic competitiveness. Yet the loss of interest in technology education may have been indicative of an even larger issue, the loss of a fundamental aspect of the United States' core principles. Twentieth-century educational reformer John Dewey strongly believed a technological, or industrial education, was necessary for a healthy democracy.

Dewey stated industrial education should:

utilize active and manual pursuits as the means of developing constructive, inventive and creative power of mind. It will select the materials and the technique of the trades not for the sake of producing skilled workers for hire in definite trades, but for the sake of securing industrial intelligence – a knowledge of the conditions and processes of present manufacturing, transportation and commerce so that the individual may be able to make his own choices and his own adjustments, and be master, so far as in him lies, of his own economic fate . . .

Dewey recommended students should utilize all the resources of public education to “control their own future economic careers, and thus help in such a reorganization of industry as will change it from a feudalistic to a democratic order” (Dewey, *Learning to Earn: The Place of Vocational Education in a Comprehensive Scheme of Education*, 1917, pp. 334-335). Buffalo's Dr. Daniel Upton foreshadowed Dewey's sentiments of the continuing importance of humanity and its collective technology education competency when he said “no matter how many machines are introduced, the average of intelligence among the workers will determine, largely, efficiency . . .” (Upton D. S., *Manual Training; Buffalo's Future*, 1903, p. 4).

If, as Dewey and Upton suggested, the pursuit of technology education is a vital responsibility of United States' citizens to maintain a healthy democracy, why had students veered away from these courses of study? Perceived job instability, difficulty of curriculum, and a lack of encouragement in STEM subjects at an early age appeared to be some of the reasons. While changes in middle school or secondary curriculum could



have been made to incent traditional students to pursue a postsecondary technology education, nontraditional students presented another opportunity. Job predictions released in 2012 by the U.S. Department of Labor indicated growth for the employment sectors within the scope of this study. Many nontraditional students returned to college to learn new skills. Frequently they turned to for-profit or nonprofit online colleges to meet that need. It was possible the same Internet-based technology that provided competition to Buffalo State College may have also benefitted its programs. Buffalo State's technology programs had a rich history, taught by an excellent faculty. If it could extend its base of students beyond the Western New York region (which has suffered from a loss of the jobs), BSC may have been able to attract a larger body of students to its technology programs.

Another factor, student gender, while not a direct focus of this study, had a significant impact to both postsecondary college technology enrollment and professional certifications. Nationally and at Buffalo State College, enrollment in degree-granting postsecondary technology programs declined, while overall enrollment increased and more women than men were enrolled. Yet enrollment in postsecondary college technology programs remained overwhelmingly dominated by men. Interviews conducted for this study with women who pursued technology education and careers suggested it was important to show young women, especially at the middle school or early high school level, the potential for technology careers and to encourage their participation in STEM programs. There did not appear to be a lack of aptitude or desire for women to study technology. However, environmental factors often discouraged young women's enrollment in technology programs. Moreover, in some demographic

sectors, they did not have visible role models to emulate, although innovative programs such as Tech Savvy have been instituted to initiate positive change.

The finding of the present study to target middle and high schools students for enrollment in STEM postsecondary programs was validated by a special program at Buffalo State College, *Engineers of the Future*. The 2007 summer school teacher training initiative was funded through a \$1.7 million grant from the NYS Education Department. *Engineers of the Future* provided 350 teachers from throughout New York State with the knowledge and skills to ignite an interest in engineering as a career path for middle and high school students and to address the shortage of American engineers. Four critical engineering areas, required for the future economy in Western New York and the nation, were emphasized: design and innovation; engineering and prototyping; biotechnology and bioengineering; and digital electronics and control systems (\$1.7 Million ‘Engineers of the Future’ Program Addresses Potential Shortage of U.S. Engineers, 2007, para. 1, 4). The *Engineers of the Future* program included a set of eight middle and high school courses modeled on the design and technology curriculum of the United Kingdom (Committee on K–12 Engineering Education, 2009, p. 195).

A 1999 report by the U.S. Department of Commerce referenced in Chapter One of this study recommended the creation of more positive television and motion picture roles for technologists. It especially recommended media should have been more inclusive of women and minorities in those roles because they had the ability to impact students’ choice of education and career (Meares & Sargent Jr., 1999). Since that report was published, some success had been made with a measurable impact on the ability to influence students. CBS’ popular crime drama television show, *NCIS*, included a

pigtailed female forensic specialist character named Abby Sciunto, seen by more than 20 million viewers each week. The success of *NCIS* led to other female technical roles on television. The character of Abby Sciunto was played by actor Pauley Perrette who also participated in a public-service campaign to promote careers in science and technology.

*NCIS* and the public-service announcements made a positive impact. Perrette said:

They call it the Abby Effect . . . I get letters . . . from people all the time, all over the world – parents, grandparents, kids themselves – that say this fictional character that I play [influenced them] and now they’re pursuing math and science . . . to be able to play this character that has literally made young girls think that it’s OK for them to pursue math and science is unbelievable (Gray, 2011, p. C1).

Influential television dramas such as *NCIS* and other programs may have helped to increase female student enrollment in STEM programs which, in turn, also increased the likelihood for their participation in technology correlated professional certifications.

According to a 2011 *Network World* article, some colleges reported modest gains in their computer science and computer engineering programs since reaching a low point in 2007 or 2008. Some attributed its rise, in part, to the hipster image of computing celebrities such as Apple’s Steve Jobs (whose death renewed his fame); and Facebook’s Mark Zuckerberg who was portrayed in the motion picture *The Social Network* (Marsan, Hottest major on campus? Computer Science, 2011, para. 1).

Most students who pursued a college education chose programs that appealed to their interests and provided a path for gainful employment or income production upon graduation. This was meaningful because of the intersection between professional certifications and postsecondary college technology programs, especially as they related to job opportunities. While STEM enrollments were down, according to the National Labor Bureau, through the year 2020 jobs were predicted to experience modest growth in

the subject areas within scope of this study, some significantly so. Nationally, the citizens of the United States have been reminded of the need for a technology-literate and educated society for decades. In a speech delivered in 1963, President John Kennedy advocated for free trade with Europe and Japan. He said even if the U.S. lost some of its factory jobs, it could make it up by being the bankers, engineers and teachers of the world. As noted in a 2011 article that analyzed the Recession of 2008, the problem was “not necessarily the vision of a post-industrial economy, but the botched execution. It’s difficult to be the [world’s] leading designer when your education system isn’t producing enough capable engineers” (Reddy, 2011, p. G1).

Interestingly, while national enrollment in postsecondary college technology programs was static or declined, professional certifications programs grew. This study cannot conclusively answer the fundamental question of why is enrollment in traditional technology programs had declined while at the same time technology job projections predicted growth and professional certifications became popular. However, data gathered for this study suggested one reason may have been a lack of integration with college programs and a lack of encouragement for students before they get to college (or for undeclared freshmen).

Most of the respondents to the survey instrument used within the scope of this study stated they had a single individual (their father, mother, or a teacher) who positively influenced and encouraged them to pursue their technology education and subsequent career. While not surprising, this finding underscored the importance a single person could have on the life and educational/career choices of a student. James Stranz, Chair of the Telecommunications Technology program at Erie Community College was

interviewed and shared his personal story, illustrating the significance a single individual had on his own career choice:

I didn't choose the telecommunications technology field, it somewhat chose me. Because of a job-ending injury to my back, it forced me to return to school at the age of 32. I started out in general studies and one of the first courses I signed up for was a computer applications course in the Business Administration department at Erie Community College. By the end of the first class, I felt overwhelmed and wanted to quit! Thankfully, the teacher encouraged me and talked me out of it. The teacher was moonlighting from the Communications Equipment Technology department. I was so impressed with him I followed him and eventually matriculated into that program (Stranz, 2011).

For those students who selected technology as their chosen field, respondents stated they felt they possessed a natural aptitude for technology and positive educational or validation experiences during childhood. Specific to Buffalo State College, 75 percent said their job was strongly or moderately correlated to their field of study and 67 percent said their choice of a BSC program strongly or moderately prepared them for their job.

No correlation could be drawn between students' choice of technology programs and the overall rise of professional certifications. However, one aspect of the study suggested professional certification programs may have had a large impact on the choice of postsecondary college technology programs for students of both genders. During the first decade of the twenty-first century, changes in government funding greatly increased the integration of publicly-funded schools and professional certifications. Because of the influence and funding of the Perkins Vocational Act, several states including North Carolina, Florida, and New York began to implement professional certification assessments in their secondary technology programs. In addition to Perkins criteria required for funding of the states' vocational programs, certifications provided a valuable

credential and process to instill confidence, fondness, and commitment to a postsecondary college technology education and career for high-school students.

For example, the Cisco Networking Academy and Microsoft Information Technology Academy/Microsoft Technology Associate program were particularly successful integrating into secondary technology programs. The programs built on a process whereby students felt they attained an internationally-recognized entry-level credential. Perhaps even more important, it encouraged students to build upon their accomplishments by pursuing a postsecondary college degree and additional certifications. Mr. Jeff Lesinski, director of the Computer Networking Associate program at Trocaire College in Buffalo (a two-year postsecondary program with a focus on associated professional certifications) was interviewed for this study. Lesinski stated one of the most consistent referral sources for students in the Trocaire program came from the Erie 1 BOCES secondary Cisco Networking program.

There were also national efforts to bolster the inclusion of computer science classes within high schools that included certifications. Computing in the Core (CinC), a non-partisan advocacy coalition of associations, corporations, scientific societies, and other non-profits was formed to elevate computer science to a core academic subject in K-12 education. Since 2009, CinC sponsored the National Computer Science Education Week, held the second week each December to raise awareness for the need to build a strong computer science education program (Computing in the Core, 2011, para. 3). CinC advocated for a national adoption of the Association for Computing Machinery's model curriculum. The curriculum culminated with specialized courses that led to industry certifications for advanced secondary students who pursued advanced studies in

computer science, engineering, or engineering technology in college (Stephenson, Gal-Ezer, & Verno, 2005, pp. 33,57). In 2011, Buffalo State College participated in Computer Science Education Week. BSC's CIS department showcased video games developed by CIS freshman students and hoped to attract undeclared students to the program. BSC's participation focused on many of the recommendations identified within this study, and highlighted the tremendous job growth within the computer industry, local technology companies, and job opportunities. It also stressed the contributions of women and minorities to computer science (Banerjee, 2011, para. 1).

Another recommendation to encourage participation in four-year technology programs at BSC made by those who participated in the study survey was the suggestion of recruitment of an untapped resource: BSC technology alumni testimonials given to high school students and undeclared college freshmen to influence their education and career choice. This seemed to be an opportunity to share the benefits of a technology education to high school students who may have been interested, but undecided, on an educational path.

The final component of this aspect of this study focused on curriculum delivery. Chapter One of this study introduced the challenge of for-profit and nonprofit Internet computer-based distance learning curriculum delivery and assessment, initially developed by the professional certification industry. Novell popularized the computer-based distance learning model as documented in Chapter Two of this study. New data compiled as part of this study showed an example of how Trocaire College professor Lesinski used an Internet computer-based distance learning tool, MOODLE, to deliver professional certification integration with traditional computer classes. Similarly,

computer-based distance learning and certification processes greatly influenced Massachusetts Institute of Technology (MIT). MIT, as documented in Chapter Two of this study, led the United States in postsecondary technology education development after the Philadelphia Centennial Exposition of 1876. As chronicled in a 2011 *New York Times* article, MIT developed a free, Internet computer-based distance learning program that offered worldwide certificates to augment their education. The program offering was created when MIT enhanced its traditional programs and gave its students online tools that enriched their classroom and laboratory experiences. This development at MIT underscored the impact Internet computer-based distance learning curriculum delivery as developed by professional certification organization and Internet-based colleges had on traditional colleges like MIT (Lewin, 2011, p. 22).

**5.2.2 Perceptions of student/employer value and awareness of professional certifications.** Professional certifications had value to employees or potential employees, employers, and the organizations that provided them. While the perception of value differed based on various perspectives and of the certification itself, a fundamental aspect of this study focused on whether the value was important enough for graduates of four-year technology programs to have an expectation they needed to pursue relevant professional certifications to augment their Bachelor's degree.

Chapter Two of this study detailed the origin of the Buffalo State four-year technology programs within the scope of this study. Vocational Industrial education began in 1910 under the direction of Daniel Upton, principal of the Buffalo State Normal School from 1909 until 1918. While there was not a direct correlation between professional certifications and the technology programs at Buffalo State, the underlying



principle of the initial technology education program started at Buffalo State was what was known as the *economic factor or economic condition*. In other words, the technology program at Buffalo State (at the time called Vocational Industrial program), was established to provide value to “three classes of people, the employer, the employee, and the educator.” Harrison Givens, director of Buffalo State’s Vocational Industrial program during its formative years said the “demand of employers for men of more industrial intelligence and skill; the demand of employees for a better opportunity to become master workmen... show the demand for something which will improve the economic condition” (Givens, 1911, p. 276). While the fundamental principles upon which the technology program was formed at Buffalo State remained steadfast, there were indications that showed how dramatically times had changed and its programs adapted to changing conditions. In 1910, Givens said one of the primary objectives for the technology program at Buffalo State was to provide teachers to Vocational Schools an incentive for boys to stay in school longer than the age of fourteen. At the time, many students left school at that age because they did not see the value in enrolling any longer (Givens, 1911, p. 276).

In a contemporary perspective, there were several research areas relating to student/employer value and awareness of professional certifications explored within this aspect of the problem for this study. For this aspect, the researcher interviewed faculty members, business leaders, BSC alumni, and certification holders. While none of those interviewed for this study suggested professional certifications alone could replace a traditional postsecondary college degree, an overwhelming number of respondents said

they had value, particularly when new employment or an effort to keep skills current was sought.

In contrast with postsecondary college degrees, professional certifications had, on average, a lifecycle of approximately three years. During those three years, a certificant must have either engaged in Continuing Education Units (CEU)/Professional Development Units (PDU) or passed another exam to show current mastery of the subject matter. Current knowledge was especially important in the technology sector, as employers desired a command of the subject matter, ideally through a combination of education, certification, and most importantly, experience. Of those surveyed for this study, 80 percent stated it was important to augment a postsecondary degree with relevant professional certifications. This response underscored the understanding those who pursued an education in a technology program made a career-long, if not lifelong, learning commitment to study technology.

An interesting result of the study emerged from the various data collection and analysis activities. Although the nature and definition of professional certification was voluntary, increasingly, there were jobs that required certain certifications. Most notably, the Department of Defense required some information security job candidates to have an ANSI-accredited security certification credential. It was not certain whether this was an emerging trend amongst employers.

While a voluntary credential, from an employer's perspective, professional certifications coupled with a postsecondary degree demonstrated a job candidate was goal-oriented and had perseverance. A trend that evolved in recent years was rather than pursuing a postsecondary degree and professional certification as mutually exclusive

goals, was the integration of the two. While a degree is static, representing a moment in time of the completion of a culmination of classes, the professional certification continued, current with time.

One theme was repeated from decision makers throughout this study: while a professional certification had value and had the ability to differentiate a candidate when considering jobs, experience trumped all. Even so, the existence of professional certifications also added value.

While postsecondary college technology programs had long stressed the value of internships as a way of obtaining experience, finding employment in a students' chosen field of education remained a challenge upon graduation. Some professional certification organizations offered, in addition to their credential, local chapters where certification holders, decision makers and those who are interested in learning more about professional certifications met on a monthly basis. Within the Western New York region, such professional certification organizations included the Project Management Institute and American Society for Quality. College students and those recently graduated from a technology program could have used these local chapter organizations and their monthly meeting sessions as a way to network and gain employment leads, at the same time they pursued professional certifications.

As validated by this study, ultimately, the value of professional certifications remained subjective. For example, Greg Shields, columnist for *Redmond* magazine, said in a 2011 editorial: "We all know the certification craze is over, an artifact of a time long past" (Shields, 2011, p. 47). Yet at the nearly the same time Shields' op-ed was published, the results of a new survey were released, conducted jointly by *Network World*

magazine and SolarWinds. That 2011 survey of 700 network professionals concluded those who earned a relevant professional certification believed it benefitted their careers as a direct result. Sixty percent said a certification led to a new position and 50 percent said their salary increased. Yet those who pursued certifications did not do so solely because of the prospect of a new job or increased income. While 51 percent said they pursued a certification to position themselves for a promotion or other job, 22 percent of survey respondents said they chose to pursue a certification to learn about technology, especially technology new to the industry, or at least new to the certificant. The *Network World* survey confirmed one finding from the present study: certifications were more valuable when they were coupled with real-world experience.

For the purposes of this study, the most relevant aspect of the *Network World* study was the level of education the 700 respondents provided. Nearly 83 percent who responded to the survey had a postsecondary degree. The largest segment, were those with Bachelor's degrees at 44.4 percent; those with Associates degrees were next at 23.9 percent; high-school degrees were next at 17.1 percent; Master's degrees were next at 13.4 percent and Ph.D. degrees were last at 1.1 percent. This implied for those who believed a certification added value because of either current technology knowledge or to gain an advantage in the employment market, a certification was strongest when coupled with a postsecondary degree (Bort, 2011, p. 10).

The continued relevance of certifications was also reinforced in TechRepublic's *2012 IT Skills and Salary Report*. The report, based on a survey conducted in October and November 2011, attracted more than 9,500 respondents, 76 percent of whom lived in the United States and Canada. Sixty percent of those who pursued training in 2011 did so

for a certification. Two thirds of those respondents who obtained a certification in the past five years believed the certification was worth the commitment of time and resources. Respondents also believed certification increased job performance and the number who believed the certification process was overrated declined (TechRepublic, 2012, pp. 10-11).

While a professional certification may have had a limited lifecycle, the pursuit of knowledge and mastery of the technology covered within the scope of the professional certification accumulated and had lasting value beyond the lifecycle of the certification. William Stark, a Hewlett-Packard information technology consultant who had a number of professional certifications, said:

Despite the fact Novell's certifications are no longer relevant because of changing market conditions, I don't regret for a moment taking the time and financial resources to pursue them. Some of the information and concepts I learned are still valid and I believe Novell's certification program and educational system was the best I've encountered throughout the entire technology certification industry (Stark, 2011).

Crucial to the value proposition of certifications within the scope of this study, most technology professional certifications had varying levels of perceived value. Among those included within the scope of this study, Lean Manufacturing, ASQ/Six Sigma, Cisco, ITIL, Microsoft, and Project Management Institute certifications were among those consistently cited as having had the most value.

Much of the value of professional certifications as a credential centered on the ubiquity of Internet technologies and the reality of global competition for local jobs through the consolidation of multinational companies and outsourcing of American owned companies. As Mr. Clark Crook, former president of Synergy Global Solutions, a New York State-based information technology services firm said during the course of this

study: “It seems to me information technology jobs are the new American job that Americans don’t want to do. It’s the twenty-first century equivalent of the migrant worker apple-picking job.”

Professional certifications fulfilled an important role and provided an increasingly global world with something locally meaningful. Increasingly, technology certification holders were from outside the United States, although the majority of professional certification companies and organizations were based in the United States. (There were a few notable exceptions: organizations who issued professional certifications within the scope of this study limited to U.S. citizens.) Indeed, as noted in Chapter Two of this study, professional certifications offered the ability to homogenize various regional postsecondary college technology programs as well as provided an internationally-recognized credential of a particular set of technology skills.

Participants in this study expressed the sentiment citizens of the United States had a very important mission to keep America a frontrunner in the development and use of technology, to stay current with trends and to utilize technology creatively and competitively. While there was value in an internationally-recognized credential such as a professional certification, work remained to be done, most notably the need to create a professional certification standardization system. Those who took part in the 2011 Microsoft Tech Ed conference *Birds of a Feather* session (focused on professional certifications), stated there remains confusion over some certification titles and expressed a need for universally understood certification levels such as traditional postsecondary Associate’s, Bachelor’s, and Master’s degrees.

While some respondents to this study indicated relevant professional certifications had value, there was some question as to whether the value of the certification was worth the amount of time, commitment and expense associated with materials, courses required, and the associated assessment exams. However, increasingly, there were ways to offset those costs for students, either through federally and state-funded One-Stop grants for the unemployed; exam costs included as part of a tuition cost associated with a professional certification-integrated class from a degree-granting institution; federal government coverage of the costs to obtain a certification through veteran's programs or for secondary students; or lastly, employer reimbursement for employees who pursued professional certifications relative to their current or future positions within their company.

If professional certifications had value and there was an expectation students should consider pursuing them, where did students learn about them? Fifty-eight percent of this study's survey respondents had at least one professional certification, and 100 percent said colleges should have made them aware of relevant certifications, if they were not fully integrated with them. While it was logical colleges might make students aware of relevant professional certifications, those who participated in this study expressed a belief that it would never happen. James Stranz, program director of the Cisco Networking Academy at Erie Community Colleges said:

I most definitely believe technology programs in traditional higher education institutions should provide information to students about the value and impact of professional certifications within their curriculum studies. However I think some "old school" professors might view it as a threat to their job, thinking a student might take the certification route to gaining employment and abandon a traditional college education (Stranz, 2011).

This finding stressed the need for students to understand professional certifications should have augmented traditional technology programs, not replace them.

**5.2.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** With the growth of professional certifications both internationally and within the United States, secondary and postsecondary educational institutions adapted to the integration of professional certifications at varying levels. At its most basic level, this aspect of study sought to answer the question: should Buffalo State College's curricula be modified to incorporate classes that prepare students for appropriate certification exams? Because of the complexity of the question, the researcher evaluated and collected data from several various sources to answer it, detailed in Chapter Three of this study.

As detailed in Chapter Two, technology education at Buffalo State College (and nationally) evolved from Manual Training to Technology Education to its current technology programs. Professional certifications had increased relevancy to postsecondary college technology programs about the same time the programs themselves evolved beyond Technology Education/Industrial Arts during the late 1960s. Of the professional certifications analyzed within the scope of this study, the three earliest were introduced in 1948, 1968, and 1969. These early pioneering certifications were quite rare; the vast majority of them were created since the mid-1990s, concurrent with the rise of the Internet and globalization.

As shown in Chapter Two, Buffalo State College's technology programs, as with similar institutions within the United States, were impacted by federal and state policies and their associated funding. Particularly important milestones included the NYS



Normal school legislation of 1866 that laid the groundwork for the creation of the Buffalo State Normal School/College; the Centennial Exposition of 1876 where the concepts of applied learning and manual training were exposed to a national audience; the Buffalo Public Schools and Common Council approval of Manual Training curricula in Buffalo in 1895; the federal Smith-Hughes Act of 1917 that authorized funding for industrial/vocational training in high schools; the NYS legislative approval of the transfer of the New York State Vocational Industrial program from Albany to Buffalo in 1919-1920; the National Defense Education Act of 1958 that provided tuition assistance and incentives for postsecondary STEM programs and provided pioneering computer technology programs in Buffalo; the federal Perkins Vocational Act of 1984, 1990, and 2006 that provided career and technical education funding for secondary and postsecondary schools and funding for professional certifications assessments; and the Post-9/11 Veterans Education Assistance Improvement Act of 2011 which provided for tuition and other financial incentives to veterans for postsecondary programs and funding for professional certification examination assessments.

Through the Perkins Act, many states such as Florida had extensively integrated certifications into their Career and Technical Education (CTE) programs. The Harvard University Graduate School of Education took notice of this development and encouraged it as a way to provide employment training for the nation's technology jobs and encourage postsecondary technology education for high-school students. In a 2011 report, Harvard said:

Our current system places far too much emphasis on a single pathway to success; attending and graduating from a four-year college after completing an academic program of study in high school. Yet . . . only 30 percent of young adults successfully complete this preferred pathway . . .

Every high school graduate should find viable ways of pursuing both a career and meaningful postsecondary degree or credential . . . There are already pockets of excellence in career and technical education in many American states and communities. . . Today's best CTE programs do a better job of preparing many students for college and career than traditional academics-only programs (Harvard Graduate School of Education, 2011, pp. 24-25).

The report concluded by underscoring the renewed relevancy of the pedagogical accomplishments of Love, Upton, and others like them who, over a century ago, built the foundations of vocational industrial training in Western New York, and across the United States. In its reinforcement of secondary CTE programs' value, the Harvard report said: "most young people learn best in structured programs that combine work and learning, and where learning is contextual and applied" (Harvard Graduate School of Education, 2011, p. 38).

While these concepts are not new, they appeared to be forgotten in each succeeding generation. In C. P. Snow's 1959 lecture *The Two Cultures* delivered at Cambridge, he condemned the British educational system for praising humanities at the expense of scientific and engineering education. Snow said:

highly educated members of the non-scientific culture couldn't cope with the simplest concepts of pure science: it is unexpected, but they would be even less happy with applied science. How many educated people know anything about productive industry, old-style or new? What is a machine-tool? I once asked a literary party; and they looked shifty. Unless one knows, industrial production is as mysterious as witch-doctoring (Snow, 1964, p. 30).

Snow continued his lecture and said technology was a natural pursuit for children because they play with mechanical toys and learn "applied science before they can read" (Snow, 1964, p. 44).

Each of the local, state and federal government programs discussed had, in their own way, shaped postsecondary technology education programs at Buffalo State College and at similar educational institutions across the nation. Meaningful to the scope of this study, the most recent federal programs included financial provisions for professional certification credentials at both secondary and postsecondary technology school programs.

To answer the essential research question of whether postsecondary college technology program graduates should have had an expectation of whether professional certifications were required for their career, the researcher interviewed faculty, professional certification organizations. Questionnaires were sent to identified, relevant certification organizations and surveys sent to program alumni. Based on the data, the following conclusions were made about certifications and their integration with secondary and postsecondary college technology programs:

- Professional certifications were global in their reach and operated in many languages;
- Professional certification organizations have been leaders in developing a global multilingual Internet-based content delivery system utilizing computerized assessment and had a large impact and influence on traditional postsecondary college technology programs;
- Professional certifications replaced neither experience nor traditional postsecondary degrees;
  - Professional certifications typically represented mastery of a current technology and had a limited lifecycle while postsecondary degrees represented a fixed moment in time but had no expiration date;
- Over the last ten years, professional certification study materials and exams for both secondary and postsecondary college technology programs had increasingly been eligible for federal and state funding through federal education legislation, federal requirements for professional certification, job development grants, and tuition assistance for postsecondary certification-integrated programs. As a result,

professional certifications were increasingly integrated with secondary, and degree/non-degree granting postsecondary educational programs.

As a result of these findings, there were a number of certifications within the scope of this study that either had direct or indirect accredited postsecondary integration. On average, a particular certification, through either classwork or examination assessment, is worth about three postsecondary credit hours.

Many professional certification holders were from outside the United States and many professional certification organizations disclosed their high international number of certificants, even as the vast majority of them are headquartered in the United States. For many American companies that grant certifications, a large percentage of their certification holders were international and crossed boundaries, forming a global, virtual community. There were a few notable exceptions, as a few professional certification organizations limited their certificants to residents of the United States (primarily in the manufacturing sector). This may have been in response to the perception of globalization being responsible for the loss of American manufacturing jobs.

As to the other fundamental question as to whether Buffalo State College should modify its technology programs to incorporate professional certifications, the answer is, as might be suspected, more nuanced. Buffalo State programs were indirectly integrated with existing professional programs through articulation agreements.

Nationally, few postsecondary baccalaureate college programs were directly integrated with professional certifications. Those programs that were integrated with certifications were typically found at community colleges, not four-year institutions.

Evidence of professional certifications' integration growth within community colleges was observed within Western New York at Jamestown Community College. Its

2010-2011 Annual Plan, part of its 2009-2014 Strategic Priorities, emphasized the college “develop strategies to become the regional center for business and industry certification and licensure to increase and enhance career paths and employability” (Jamestown Community College, 2011, p. 12).

At Buffalo State College, there was no direct integration of the six technology areas within the scope of this study and associated professional certifications, although there was an implied integration through articulation agreements with community colleges (e.g. Trocaire, Jamestown Community College, and Erie Community College) and through accreditation programs; most notably the American Council on Education.

Interestingly, there was often overlap between postsecondary college programs and associated professional certification-credentialed programs. Six Sigma, for example, was a popular program offered by many colleges (including Buffalo State College), but the curriculum was often not tied to a particular credential. This might have been the greatest opportunity for colleges like Buffalo State: the correlation of existing classes that had associated industry-recognized professional certifications.

There may have always been resistance by four-year colleges to integrate their programs with known, relevant professional certifications. Concerns included loss of independence of curriculum development as well as the perceived diminishment of a college class to the role of workforce development training. James Stranz believed technology programs in traditional higher education institutions should “include classes that can be used to obtain a professional certification, however I have several colleagues that might disagree, because they feel it crosses the line between traditional higher education and training” (Stranz, 2011).

Many postsecondary colleges may have been reticent to embrace professional certifications because of the loss of independence of program curriculum, especially for vendor-specific certifications programs such as Microsoft and Cisco. However, the overwhelming majority of certification organizations included within the scope of this study was vendor-neutral. This implied they would have more easily fit into a college degree integration strategy.

### **5.3 Limitations**

This study was limited by its scope to a limited number of technology program areas at Buffalo State College and their associated and relevant professional certifications. Because of this defined scope, the results must have been limited to these technology areas: computer information systems; industrial technology; electrical engineering, mechanical engineering, and technology education. The relatively small sample size of the alumni survey was also a limitation. The scope of the relevant professional certifications was also not exhaustive, but represented the most relevant certifications to the six BSC technology programs within the scope of this study extant during the time the research was performed.

### **5.4 Recommendations for Future Research**

While the researcher chose to limit this study to six technology programs currently offered at Buffalo State College (descendants of the its 1910 Vocational Industrial program), many of the topics explored in the course of this study could have been applied to the school's sibling program: Household Arts. The program began the

same year as Buffalo State's Vocational Industrial program (it was renamed Vocational Homemaking a few years later). The program was very important to Buffalo State's development and was the school's first program for which New York State authorized the school in 1919 to grant a Bachelor of Science degree in Home Economics. The program lived on through three contemporary Bachelor of Science programs: Dietetics; Dietetics Didactics; and Hospitality Administration. A fourth program, Fashion and Textile Technology, was contained within Buffalo State's Technology Department but the program could trace its roots to both the Vocational Homemaking and Vocational Industrial programs. Vocational Homemaking originally included sewing and millinery, and its instructors were included within the Vocational Homemaking department hierarchy. However, Vocational Dressmaking students graduated from the Vocational Industrial Department. The historic duality was reflected in its contemporary governing departments: when first created in approximately 1990, the Fashion and Textile Technology Bachelor of Science program was contained within the Nutrition, Hospitality, and Fashion Department. However, about the year 2000, the program was moved to the Technology Department. A similar study to the present one might have been undertaken to disclose important aspects of these programs and how technology professional certifications were significant as well as further exploring their rich contributions to Buffalo State College and the Western New York community. Because of the relatively small sample size of this study, additional research could have been undertaken to focus on specific technology programs at Buffalo State College and their correlation to specific professional certification programs.

The researcher would have also been remiss if he had not commented on one other item. The annual Buffalo State College yearbook, *The Elms*, had been a very important data source for this study. It was discontinued in 2007, ironically, a victim of technological change. While publishing delivery systems had evolved to reflect digital and Internet aspects, the need for content remained. It was the hope of this researcher further research would have been performed to resuscitate this important chronicle of Buffalo State College.

## **5.5 Conclusions**

While this study had a great deal of data from which conclusions might have been drawn, several were particularly noteworthy. This study aimed to answer the question whether technology students and graduates should have had an expectation to augment their education with professional certifications because of their importance. By their very nature, professional certifications were voluntary, yet they grew exponentially and fulfilled a need by employers and certificants to demonstrate knowledge in specific technology disciplines. It was a credential by which certificants could have displayed their commitment to technology education and their ability to focus on a particular technology discipline. In times of economic recession, their value may have been higher due to increased competition for a finite amount of jobs. Based on the three aspects of the problem as defined within this study, there were specific conclusions drawn from the research performed.



The relationship between the aspects of the problem and its supporting research questions to results, discussion and recommendations was summarized in Table 9 and detailed in the sections following.

Table 9. Matrix of Results, Discussion, and Recommendations Analysis.

Problem Aspect	Supporting Research Question	Results	Discussion and Recommendations
College technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery	1 How do school and program enrollments compare?	Section 4.2: Figures 26-35 and Appendix Four: Except for ME, enrollment in BSC's technology programs had declined; CIS and IT declined about 50% since 2000.	While technology enrollments declined, anticipated employment growth helped to mitigate. Recommendations to increase enrollment in technology programs included: <u>BSC technology alumni testimonials</u> given to high school students and undeclared college freshmen to inspire their technology education and career choice. Recruit <u>nontraditional, women and minority technology students</u> because of BSC's rich history with SEEK/EOP and Say Yes to Education opportunity. Leverage completion of BSC's new <u>Technology Building</u> (summer of 2013) to attract students. Identification of <u>entry-level technology classes at BSC to integrate online</u> at area high schools.
	2 What influences student choice of technology program?	Section 4.2.1: Most survey respondents and those interviewed indicated they were inspired to study technology through the influence of a parent or teacher.	
	3 How can recruitment methods be improved?	Section 4.2.1: Survey respondents and those interviewed suggested outreach utilizing BSC alumni to high school students, especially women and minorities.	
	4 Are online classes as effective as traditional classes?	Section 4.2.1: Just 13% of survey respondents believed the quality of online classes was the same as traditional classes.	
Perceptions of student/employer value and awareness of professional certifications	5 Should colleges make students aware of certifications?	Section 4.3.2: 100% of survey respondents believed there should be a mechanism to make college students aware of relevant professional certifications. 53% had certifications in their field.	There was nearly universal agreement of the value of certifications by students and alumni. While certifications are not perceived to be a replacement for college degrees, they are important (and necessary) for some jobs. Because students may not be aware of certifications, it is recommended student chapters of certification organizations (PMT, ASQ) be created. A centralized website of relevant certifications is also needed, such as those contained in Appendix Five of this study.
	6 What are certifications value to students and employers?	Section 4.3.1: All those interviewed indicated certifications had value, although value was not equal. 80% of survey respondents indicated certifications had value.	
	7 Do certifications replace or augment college degrees?	Section 4.3.1: 80% of survey respondents said certifications were important to augment a postsecondary college degree but could not replace a degree.	
Relevancy and integration of professional certifications into postsecondary college technology programs	8 What certifications are relevant to scope of study?	Section 4.4, Figure 37 and Appendix Five: 36 certification organizations and 166 certifications identified.	Community colleges are far more integrated with certification programs than 4-year institutions. Integrated classes often provide transfer credits to 4-year schools with articulation agreements. Increased government funding has encouraged certification integration at secondary and postsecondary level. A recommendation is to <u>leverage existing BSC classes closely aligned to certifications for increased enrollments and revenue streams.</u>
	9 How are relevant certifications integrated with technology programs?	Section 4.4, Figure 38, and Appendix Five: 80 certifications were accredited or integrated. Microsoft, Cisco, and CompTIA had extensive direct secondary and postsecondary integration.	
	10 Should certifications be integrated with technology programs?	Section 4.4: All survey respondents and those interviewed believed certifications should be integrated with postsecondary college technology programs.	

**5.5.1 Postsecondary college technology program student enrollment and perceptions of enrollment trends, recruitment, and curriculum delivery.** The most important conclusion from this study within this aspect was nationally, traditional postsecondary college technology program enrollments declined even as overall college enrollment increased and large numbers of baby boomers retired, including those holding technical jobs. Nationally, overall undergraduate student enrollment grew 4.3 percent from 2007 to 2010 (Chen, 2011, p. C2). These national declines were echoed in a decline of an attendant number of students in several of the BSC technology programs included within the scope of this study (most notably Industrial Technology and Computer Information Systems), even as overall Buffalo State College enrollment grew. Computer Information Systems and Industrial Technology programs experienced declines in enrollment of approximately 50 percent since 2000.

Overall, enrollment increased and a higher number of women than men were enrolled in college and obtained degrees. Yet enrollment in postsecondary college technology programs was overwhelmingly dominated by men. At the same time, technology-related professional certifications integrated into secondary programs increased. This development was important because it compelled young adults to become interested in technology subjects and to continue their education in a postsecondary STEM field after graduation from high school.

**5.5.1.1 Recommendations.** To increase enrollment in STEM programs at Buffalo State College and at other similar institutions, it was recommended they make use of an untapped resource: technology alumni testimonials given to high school students and undeclared college freshmen to influence their education and career choice.

In addition, at Buffalo State College, where there were typically a dominant number of women students and an atypically high percentage of minority students compared to similar educational institutions, there appeared to be a golden opportunity. It was recommended BSC create programs that provided pathways for minority women students to be active participants in the rich tradition of technology education at Buffalo State College.

Buffalo State had a long history in its promotion of minority student education that began with Search for Education, Elevation and Knowledge (SEEK), a program funded by New York State. SEEK was designed to meet the needs of students who were economically disadvantaged and academically underprepared. The program, begun in the mid-1960s at the City College of the City University of New York (CUNY), was extended to upstate New York through the efforts of Buffalo Assemblyman Arthur O. Eve and Senator Earl Bridges of Niagara Falls. In 1967, the Joint Legislative Committee on Higher Education requested funds to support SEEK in areas outside of New York City. Because Eve supported the legislation to expand SEEK, it was decided to allot the entirety of the funds to establish a program in Buffalo; BSC became the beneficiary of the program. It was SUNY's first effort to provide higher educational opportunities to the disadvantaged at the four-year college level. In 1967, BSC began the program with 100 full-time students and by 1970 BSC had the largest local full-time enrollment (603) of the newly-organized SEEK program.

The successor to SEEK was the Educational Opportunity Program (EOP). Assemblyman Eve expanded the original program and codified it into law. The EOP model integrated SEEK into BSC's existing structures and brought EOP students directly

into the college setting with other students (previously they were separated). The program was designed for students of all races and ethnicities who had the talent and ability to succeed in college but had been placed at a disadvantage for access by financial and academic circumstances. Buffalo State typically enrolled 900–975 EOP students annually. An average of 300 new EOP students was admitted each year. In 2007, EOP was officially renamed the Arthur O. Eve Educational Opportunity Program in recognition of the former deputy speaker of the state assembly for his foresight and commitment to educational equity that opened the doors of higher education to so many (Medina & Scott, 2010, pp. 246-247). In 2012, Eve was honored during the annual Martin Luther King, Jr. commemoration sponsored by the African American Roswell Employee Network in recognition for Eve's work on behalf of the underserved in education (Eve to be honored Friday at King commemoration, 2012, p. D3).

Because of the rich SEEK/EOP heritage to meet the needs of disadvantaged students, Buffalo State was uniquely positioned to take advantage of the Say Yes to Education Buffalo Promise Scholarship. Beginning in June 2013, any Buffalo resident who graduated from a traditional public or charter school in the city was eligible to have some or all of their tuition paid at a two or four-year SUNY or CUNY postsecondary school, as long as they had continuously attended a city school for at least four years (Pasciak & McNeil, 2011, p. A1). As a result, Buffalo State may have seen an influx of even more disadvantaged college students who may have pursued degrees in the six technology areas within the scope of this study.

The strategy to reach out to high schools had been used successfully in other areas of the United States. For example, a Cisco partnership in Seattle paired some female

students with female IT professionals who described the opportunities in the field. Other schools exposed students in middle schools to IT issues and available high school certification classes. Other schools asked guidance staff members to describe Cisco classes to female students who may be interested or sought to cultivate female student leaders who were willing to share information about Cisco with other students (Haimson & VanNoy, 2004, p. 68).

It might have been ideal to target students at an earlier age who were interested in technology programs at Buffalo State. Working with Buffalo Public Schools Career and Technology education program, relevant professional certifications might have been introduced at the secondary level that could have led students, such as minority girls, to further their education at Buffalo State College technology programs. This would have been a logical progression since it was likely many minority students will attend postsecondary programs at BSC.

Another recommendation made was to focus on older women who returned to college, or attended for the first time. Older women returned to college for career changes, according to a study at Columbus State. During fall 2010 semester, 1,334 women age 25 or older enrolled at Columbus State for the first time, a 56 percent increase from autumn 2007. Older female students returned to school because they lost their jobs and sought to learn skills to improve their career prospects. Women also turned to careers they had not sought in the past, such as classes required for warehouse and distribution jobs. Women were interested because of the demand for jobs and the industry's shift to computers (Boss, 2012, p. B7). As nontraditional women students sought a college education, there may have been opportunities to increase enrollment

from this sector through existing channels focused on this group, or to have created new ones.

Completion of the Buffalo State's new Technology Building anticipated in the summer of 2013 will have undoubtedly positively impacted enrollment in the Technology and Computer Information Systems department programs. In addition to the building having met very real program needs, it served as a symbol of Buffalo State's commitment to provide fine technology programs, instructed by qualified faculty and housed in start-of-the-art facilities. However, an important enrollment recruitment opportunity may have been missed with the production of the slick and engaging six minute video, *Buffalo State College New Technology Building* by the S/L/A/M Collaborative. The video featured an animated exterior and interior tour of the building and showed approximately eleven interior spaces. Each interior scene was populated with people, presumably students and faculty. While a tour around the exterior of the building exhibited the racial and gender diversity found on Buffalo State's campus, as the animation entered the building, its double entrance doors were flanked by four Caucasian men. Additional scenes also generally featured a Caucasian audience. In the two workshops featured on the first floor, only men were present and the vast majority of them were Caucasian. The computer and sewing labs shown on the second and third floors exhibited improved gender diversity, although not racial diversity. The computer lab was populated by eleven Caucasians, five of whom were women. The sewing lab was populated by six individuals, three of whom were women; one of the men may have been non-Caucasian. This video was prominently posted on Buffalo State's website (Buffalo State College Finance and Management Office, 2012). It was recommended future promotional efforts

or press release images associated with the new Technology Building accurately reflect Buffalo State's campus gender, racial diversity, and diversity opportunities within the Technology and Computer Information Systems department programs such as women and minorities; even if such diversity did not presently exist within each program.

A final recommendation was to identify entry-level technology classes at Buffalo State that might have been introduced online at area high schools (perhaps in a partnership with Erie 1 BOCES). These programs would simultaneously have provided both high school and college credit. Similar to the model established by Microsoft and Cisco, this process provided credit incentives for high school students who were considering attending college, but also provided a definite and committed path for students who planned to college.

**5.5.2 Perceptions of student/employer value and awareness of professional certifications.** The most significant conclusion of this study found professional certifications had value; particularly when certificants sought new employment or to keep skills current.

Professional certifications may have offered an additional value that postsecondary colleges could not. While postsecondary technology programs had long stressed the value of internships as a way to obtain experience for students, finding employment in a students' chosen field of education remained challenging upon graduation. Some professional certification organizations offered, in addition to their credential, local community chapters where certification holders, decision makers and those interested in learning more about professional certifications met on a monthly basis. Examples included professional certification organizations such as the Project



Management Institute (PMI) and American Society for Quality (ASQ). Both of these organizations had chapters within the Western New York area. College students and those recently graduated from a technology program could have used these sessions as a way to network and gain employment leads.

Most certifications had varying levels of perceived value. Among those included within the scope of this study, Lean Manufacturing, ASQ/Six Sigma, Cisco, ITIL, Microsoft, and Project Management Institute certifications were among those consistently cited as having the most value.

As echoed several times in this study, professional certifications fulfilled an important role as they provided a global world with something locally meaningful; essentially being a franchised form of technology education. Increasingly, certification holders were from outside the United States, although the majority of professional certification organizations were based in the United States. Regardless of whether certifications were integrated into postsecondary college technology programs, those former students interviewed for this study expressed a desire that as a student, there should have been a mechanism to have made them aware of relevant professional certifications and potential impact on their careers.

**5.5.2.1 Recommendations.** Through the course of this study, various certifications were recognized to have had significant value in various technology contexts, including Six Sigma, Cisco, CompTIA, and Microsoft, among others. In addition, these certifications had the potential to be a bridge between school and a job if the certification organizations offered local chapters, clubs, or user groups. However, the largest challenge was how did students learn about relevant professional certifications?

Some Internet websites (such as One Stop) correlated job codes to some of the professional certifications. Another website, GoCertify, published information about significant information technology certifications. To the best of the researcher's knowledge, there was no website or source of information that was updated on an ongoing basis that contained at least the same amount of information (or more) as the table contained in Appendix Five. It correlated professional certifications relative to the six technology programs within the scope of this study. Posting the table on a website and writing a brief article about it could have been a place to begin the process to make students aware of relevant professional certifications.

**5.5.3 Relevancy and integration of professional certifications into postsecondary college technology programs.** The study of this aspect of the problem began by asking the question: Should Buffalo State College's curricula be modified to incorporate classes that prepare students for appropriate certification exams; and should postsecondary college technology graduates have an expectation of whether professional certifications are a requirement for their career?

While the research contained in this study showed professional certifications cannot be considered a requirement for jobs (with notable exceptions), there was no question they added value and offered a competitive advantage to candidates who sought employment. Still, many companies required a four-year college degree for a relevant job. Research showed the greatest number of job openings within New York State within the next several years will have demanded a two-year degree as its minimum requirement. Further, several employers interviewed for this study suggested a candidate for a job with a two-year degree coupled with a relevant professional certification might

have been be more qualified for a position than a graduate of a four-year institution without a relevant professional certification. Therefore, it was important for college graduates, particularly those in technology fields, to have obtained professional certifications. In many cases, a graduate of a two-year college and a four-year college may have competed for the same job whose minimum requirements may have been only be a two-year degree.

In addition, with increased government incentives for professional certifications including those targeted to veterans, the unemployed, and for secondary schools and community colleges through the Perkins Act, increasingly professional certifications were part of the hiring process equation. Because college credit-granting programs were often subsidized (through federal Perkins funds, other state and federal grants to schools, and federal student grants and loans) these programs were often more accessible to lower-income students. Although most non-credit programs charged a substantial tuition fee to cover the full cost of the program, some non-credit classes were subsidized through federal and state workforce grants (including Workforce Investment Act funds) which were often targeted to specific groups such as unemployed workers.

The focus of this aspect of the study was to determine the level of postsecondary integration with a professional certification program. Some, like Cisco and Microsoft, were far more comprehensive than others. One of the advantages of integrating a technology program with a professional certification was the promise of homogenizing regional postsecondary technology curricula. This was sorely needed in some areas, particularly Industrial Technology. However, concerns for the loss of curriculum autonomy and independence when a postsecondary technology program was tied to a

particular vendor's certification program usually swayed decision makers away from integration, at least at four-year colleges.

While there may have always been debate about whether entire programs should have been fully integrated into professional certification programs, it was important to remember a professional certification translated into one three-hour undergraduate class. Therefore, the potential existed to integrate professional certifications on a class-by-class basis.

Some educators had concerns about the integration of postsecondary college programs or classes with specific professional certifications. They believed it may have encouraged program abandonment or increased dropout rates, but that did not have to be the case. Students needed to be aware professional certifications were best suited to augment traditional technology programs, not to replace them. In some respects, professional certifications integrated with specific college classes may have actually helped with four-year program retention and graduation rates. It gave a student, upon successful completion of the associated assessment, an immediate gratification: an independent, internationally industry-recognized credential.

The findings from the present study agreed with the concepts expressed by entrepreneur and University at Buffalo professor Mark Goldman in a 2012 *Buffalo News* editorial focusing on economic development in Western New York. Goldman said:

Economic development strategies therefore must be rooted in existing community assets - on who we are and on what we have - rather than an imagined notion of who and what we would like to be. By thus strengthening and reinforcing our existing assets we will, gradually but lastingly, increase demand for all that this community has to offer.

The first recommendation Goldman offers to build on community assets is to strengthen the region's already strong commitment to vocational and technical education. Goldman said:

Recognizing the far higher graduation rates among students in vocational and technical programs, a coordinated educational program of learning institutions already working in this area - Erie I BOCES, region-wide public schools and community colleges - needs to be created that will develop and then expand improved curricula and innovative teaching techniques in market-oriented training that is related to the larger economic development plan. By effecting a better integration of academic and vocational studies, we need to create educational programs that would prepare students for lasting and rewarding employment, further education and lifelong learning (Goldman, 2012, p. G2).

While Goldman did not explicitly refer to professional certifications, they were implied in his reference to lifelong learning. In essence, a plan for technology students to stay current in technology included a foundation of a postsecondary college education augmented with specific technology education such as that offered by professional certifications.

**5.5.3.1 Recommendations.** There was often overlap between postsecondary college programs and associated professional certification-credentialed programs. Six Sigma, for example, was a popular certification program offered by many colleges (including Buffalo State College in MET 630/INT 594 Lean Manufacturing/Six Sigma classes), but the curriculum is often not tied to a particular credential. This might have been the greatest opportunity for colleges like Buffalo State, to correlate existing classes that had industry-recognized professional certifications. In this case, the industry-standard credential was the American Society for Quality (ASQ) Six Sigma Green or Black Belt.

Other classes at Buffalo State College that were part of existing technology programs with relevant professional certifications included Buffalo State's safety classes, specifically SAF 305 - Fundamentals of Safety. This class could have been linked to the Associate Safety Professional (ASP) certification offered by the Board of Certified Safety Professionals. In addition to providing a stand-alone industry-recognized credential, it was also one of two exams required for the more advanced Certified Safety Professional (CSP) credential. A few other examples included ATMAE's Certified Technology Manager (CTM) or Certified Manufacturing Specialist (CMS). While these credentials were not tied to one particular class, their underlying Book of Knowledge (BOK) provided an internationally homogeneous basis for curriculum against which Buffalo State College's Industrial Technology program could have been measured. A final example included CIS 391 Project Management from Buffalo State's Computer Information Systems' program. A comparable industry-standard credential included CompTIA's Project+ certification or the Project Management Institute's Certified Associate in Project Management (CAPM) certification credential. While this list is not exhaustive, it illustrated various current technology class curricula at Buffalo State College could have been mapped to relevant professional certifications to serve as preparation for students to take these industry-standard assessments.

In addition to the six technology programs included within the scope of this study, Buffalo State College also included two undergraduate minor options: Quality and Safety Studies. There were several professional certifications appropriate to these minors from the American Society for Quality and the Board of Certified Safety Professionals.

Another opportunity was for existing college clubs that related to specific program majors to have created a user or study group independent of the college to have provided a study option geared to achieve a professional certification. The achievement of a relevant professional certification will have augmented the field of study and provided a marketable internationally-recognized professional credential in addition to a Bachelor's degree.

**5.5.5 Summary.** Chapter Five discussed the findings of the data gathered as part of this wide-ranging study. Buffalo State College's century-old rich tradition of quality and adaptive technology education uniquely qualified it to grow its programs into the emerging space of digital learning, reaching nontraditional technology students such as veterans, minorities, women, and students from outside its immediate geographic region. By taking a holistic view of student needs, it could have made students aware of relevant professional certifications and potentially offered them to compliment courses that already exist (tightly coupled with existing certifications). The research gathered as part of this study, while specific to the programs, history and demographics of Buffalo State College, could have applied to countless similar educational institutions of higher learning throughout the United States. This researcher planned to keep abreast with changes and growth in the professional certification and higher education fields and planned to implement some of the strategies recommended in this study in the researcher's role as technical manager, as part of an ongoing professional development plan for employees.

## Appendix One

### Buffalo State College Technology Program Descriptions Within Scope of Study

#### **Computer Information Systems, B.S.**

The computer information systems program prepares students for entry-level positions, such as programmer, systems analyst, or network support in the computer field, and provides them with the technical knowledge and managerial skills necessary for a wide range of subsequent career paths. There is a growing demand in all sectors for individuals with this combination of capabilities. This program was developed with the cooperation of employers and information systems professionals and, unlike a computer science program, its emphasis is on commercial applications of computers rather than theory (Buffalo State College, 2009, p. 55).

#### **Electrical Engineering Technology: Electronics, B.S.**

Electrical engineering technologists who specialize in electronics are employed in the design, testing, fabrication, and application of solid-state circuits and systems (both digital and analog), communication systems, and control systems. This includes consumer products, as well as industrial electronics and computer equipment. Hands-on laboratory experience is provided in integrated lecture/lab courses to introduce students to the electronic design, fabrication and test process (Buffalo State College, 2009, p. 62).

#### **Electrical Engineering Technology: Smart Grid, B.S.**

The Smart Grid option at Buffalo State College is designed to provide the skills for operation, maintenance, testing, analysis and sales of electrical power components and systems in the power generation, manufacturing and construction industries. Many Buffalo State College graduates of this program have been hired for administrative trainee positions requiring technical knowledge of power systems. Application oriented hands-on laboratory experience is provided in integrated lecture/lab courses to introduce students to power generation, distribution and electrical machines. Computer tools for design, analysis and simulation, as increasingly used in industry, are integrated into all higher level courses (Buffalo State College, 2011).

#### **Industrial Technology, B.S.**

The industrial technology program, through its two concentrations, provides students with the opportunity to develop a specialty within a broader framework of operations knowledge.

By selecting the *manufacturing concentration*, the student specializes in direct manufacturing support of a technical or managerial nature. Knowledge of management principles, physical sciences, technology of industry, and liberal arts is employed to optimize manufacturing processes, materials, and personnel.

The *quality concentration* allows the student to develop the ability to assist the organization in obtaining the maximum level of quality performance in providing products or services. This concentration requires a professional internship that places the student in a specialty position in a local organization as a culminating activity. Program graduates have filled positions as industrial engineers, quality-assurance specialists,



operations supervisors, trainers, and technical sales and marketing specialists (Buffalo State College, 2009, p. 71).

### **Mechanical Engineering Technology, B.S.**

The Bachelor's degree in the mechanical engineering technology program is designed to give the student a broad education in the areas of mechanical design, mechanics, stress analysis, thermosciences, and manufacturing. Graduates are in high demand and are employed by manufacturing companies, consulting firms, government agencies, testing laboratories, and other enterprises that require people with strong mechanically oriented backgrounds. Graduates work as mechanical designers developing new products, manufacturing supervisors solving problems of producing these products for performance or quality, as plant engineers improving or maintaining factories, and in technical sales selling these products. The duties of technologists may involve overseeing installation, operation, maintenance, and repair to ensure that machines and equipment are installed and functioning according to specifications; specifying system components; supervising drafters in developing the design of products; testing and evaluating products; and or/developing cost estimates (Buffalo State College, 2009, p. 75).

### **Technology Education, B.S.**

The technology education program prepares students to teach technology and the technological systems utilized in problem solving. The four systems emphasized are construction, manufacturing, communication, and transportation. The program is laboratory oriented, teaching the important role of engineering a product or service through selecting and systemizing knowledge for the solution of a problem. Graduates are recommended for an initial certificate to teach technology education in grades K–12 (Buffalo State College, 2009, p. 92).

## Appendix Two

### Certification and Technical Education Survey Questions

#### Background

Name \_\_\_\_\_

Category:

- ☐ BSC alumni of the six programs included in this study
- ☐ BSC and other relevant technology faculty
- ☐ Technology hiring managers and industry leaders
- ☐ Professional certification holders or alumni of regional technical colleges

Did you graduate from Buffalo State College?

- ☐ Yes
- ☐ No

If you graduated from Buffalo State College, from which technology program did you graduate?

- ☐ Computer Information Systems, B.S. (0825)
- ☐ Electrical Engineering Technology: Electronics, B.S. (0821)
- ☐ Electrical Engineering Technology: Smart Grid, B.S. (0820)
- ☐ Industrial Technology, B.S. (0810)
- ☐ Mechanical Engineering Technology, B.S. (0822)
- ☐ Technology Education, B.S. (0500)

If no, what is your highest level of formal technology education?

Institution \_\_\_\_\_

Degree \_\_\_\_\_

When did you graduate from your last formal educational degree?

- ☐ Less than 1 year ago
- ☐ Between 1 and 5 years ago
- ☐ Between 6 and 10 years ago
- ☐ More than 10 years ago

Are you currently employed?

☐ Yes

☐ No

If you are employed, do you believe your current occupation correlates to your formal education and/or professional training?

☐ 5 – Strong correlation

☐ 4 – Moderate correlation

☐ 3 – Somewhat correlates

☐ 2 – Minimal correlation

☐ 1 – No correlation

If you are employed, how would you classify your job?\*

- ☐ 11-3020 Computer and Information Systems Manager
- ☐ 11-3050 Industrial Production Manager
- ☐ 11-9040 Architectural and Engineering Manager
- ☐ 15-1121 Computer Systems Analyst
- ☐ 15-1122 Information Security Analyst
- ☐ 15-1131 Computer Programmer
- ☐ 15-1132 Software Developers, Application
- ☐ 15-1134 Web Developer
- ☐ 15-1141 Database Administrator
- ☐ 15-1142 Network and Computer Systems Administrator
- ☐ 15-1143 Computer Network Architect
- ☐ 15-1151 Computer User Support Specialist
- ☐ 15-1152 Computer Network Support Specialist
- ☐ 15-1199 Computer Specialist, All Other
- ☐ 17-2061 Computer Hardware Engineer
- ☐ 17-2071 Electrical Engineer
- ☐ 17-2072 Electronics Engineer, Except Computer
- ☐ 17-2112 Industrial Engineer
- ☐ 17-2141 Mechanical Engineer
- ☐ 17-2199 Engineers, All Other
- ☐ 17-3012 Electrical and Electronics Drafter
- ☐ 17-3013 Mechanical Drafter
- ☐ 17-3019 Drafter, All Other
- ☐ 17-3023 Electrical and Electronic Engineering Technician
- ☐ 17-3024 Electro-Mechanical Technician
- ☐ 17-3026 Industrial Engineering Technician
- ☐ 17-3027 Mechanical Engineering Technician
- ☐ 25-1021 Computer Science Teacher, Postsecondary
- ☐ 25-1032 Engineering Teacher, Postsecondary
- ☐ 25-1194 Vocational Education Teacher, Postsecondary

- ☐ 25-2023 Career/Technical Education Teacher, Middle School
- ☐ 25-2032 Career/Technical Education Teacher, Secondary School
- ☐ Other Engineer
- ☐ Other Manager/supervisor
- ☐ Other Professional/analyst
- ☐ Other \_\_\_\_\_

\*Based on 2010 U.S. Dept. of Labor Standard Occupational Classification

If yes, how would you classify your business sector?\*\*

- ☐ 11 Agriculture, Forestry, Fishing and Hunting
- ☐ 21 Mining, Quarrying, and Oil and Gas Extraction
- ☐ 22 Utilities
- ☐ 23 Construction
- ☐ 31-33 Manufacturing
- ☐ 42 Wholesale Trade
- ☐ 44-45 Retail Trade
- ☐ 48-49 Transportation and Warehousing
- ☐ 51 Information
- ☐ 52 Finance and Insurance
- ☐ 53 Real Estate and Rental and Leasing
- ☐ 54 Professional, Scientific, and Technical Services
- ☐ 55 Management of Companies and Enterprises
- ☐ 56 Administrative and Support and Waste Management and Remediation Services
- ☐ 61 Educational Services
- ☐ 62 Health Care and Social Assistance
- ☐ 71 Arts, Entertainment, and Recreation
- ☐ 72 Accommodation and Food Services
- ☐ 81 Other Services (except Public Administration)
- ☐ 92 Public Administration, Government
- ☐ Other \_\_\_\_\_

\*\*Based on the North American Industry Classification System (NAICS)

If you graduated from one of Buffalo State College's technology programs, do you believe the program adequately prepared you for your job?

- ☐ 5 – Strongly prepared
- ☐ 4 – Moderately prepared
- ☐ 3 – Somewhat prepared
- ☐ 2 – Minimally prepared
- ☐ 1 – Not prepared

Are you currently in a position to hire or recommend for hire candidates for computer systems, mechanical engineering, industrial technology, electrical engineering or technology education employment positions?

☐ Yes

☐ No

**Enrollment/Recruitment**

What influenced your decision to select your formal education major? \_\_\_\_\_

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What influenced your decision to select the college from which you graduated? \_\_\_\_\_

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Did you have a mentor or significant other person who encouraged you to pursue your major?

☐ Yes

☐ No

If yes, who was that person? \_\_\_\_\_

If you were recruited into an technology program at Buffalo State College, which of the following do you believe are effective recruitment mechanisms (check all that apply):

☐ Internet website

☐ Internet-based Youtube-style videos

☐ Internet-based webinars

☐ Glossy printed Viewbooks

☐ Tri-fold brochures

☐ Guidance counselors

☐ Direct outreach to high-school or community college students

☐ Other \_\_\_\_\_

Some technology enrollments in formal education institutions are decreasing nationwide. What do you think could be done to increase interest and enrollment?

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Have you ever taken an online/computer-based/distance education class for a professional certification or from a for-profit college (i.e. University of Phoenix)?

☐ Yes

☐ No

If so, do you believe they are as or more effective than traditional classes?

☐ Yes

☐ No

### **Professional Certification Awareness**

A professional certification is a voluntary, nationally or internationally recognized non-governmental process for ensuring professional competency based on standards and requirements to ensure a requisite knowledge, skills, and abilities to perform at the pre-determined level in the profession. Do you have an awareness of the major professional certifications relevant to your job and academic degree?

☐ Yes

☐ No

Do you believe technology programs in traditional higher education institutions should provide information to students about value and impact of professional certifications within their curriculum studies?

☐ Yes

☐ No

### **Professional Certification Value and Integration**

Do you currently hold any professional certifications?

☐ Yes

☐ No

If so, what are they? \_\_\_\_\_

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Do you plan to pursue any professional certifications within the next 12 months?

☐ Yes

☐ No

If so, what are they? \_\_\_\_\_

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Do you believe professional certifications are important to augment a formal technology degree?

- ☐ Yes
- ☐ No

If yes, what benefits do you ascribe to a professional certification?

- ☐ Higher salary
- ☐ Increased marketability to potential employers or for jobs that require certified individuals
- ☐ Career progression at current employer
- ☐ Current job stability/security
- ☐ Increased helpfulness to current employer
- ☐ Differentiation among peers
- ☐ Increased technical knowledge, recognized credentials/qualifications and confidence
- ☐ Commitment to profession
- ☐ Participation in national/international skill quality standards
- ☐ Professional membership benefits

Do you believe vendor-neutral professional certifications are more valuable than vendor-specific certifications?

- ☐ Yes
- ☐ No

Do you think professional certifications can replace a traditional college degree?

- ☐ Yes
- ☐ No

Do you think technology programs in traditional higher education institutions should include classes that can be used to obtain a professional certification?

- ☐ Yes
- ☐ No

**Buffalo State College and Community College Dual Admission/Articulated Technology Programs**

Buffalo State College	Degree	HEGIS	Curriculum Code	Erie Community College	Degree	HEGIS	Curriculum Code	Niagara County Community College	Degree	HEGIS	Curriculum Code
Computer Information Systems	BS	0702	0825	Computer Science	AS	5101	0532	Computer Science	AS	5101	COMP
				Information Technology	AAS	5101	1492	Computer Information Systems	AS	5101	CIS
Electrical Engineering Technology: Electronics	BS	0925	0821/0831	Electrical Engineering Technology	AAS	5310	0699	N/A	N/A		
Electrical Engineering Technology: Smart Grid	BS	0925	0820/0830	Electrical Engineering Technology	AAS	5310	0699	N/A	N/A		
Industrial Technology	BS	0925	0810	Industrial Technology	AOS	5312	0583	Mechanical Technology	AAS	5303	MECH
				Civil Engineering Technology	AAS	5309	0517				
Mechanical Engineering Technology	BS	0925	0822/0832	Mechanical Engineering Technology	AAS	5315	0493	Mechanical Technology: Mechanical Design	AAS	5303	MECH
Technology Education	BS	0839.01	0500	N/A	N/A	N/A	N/A	N/A	N/A		



**Buffalo State College and Community College Dual Admission/Articulated Technology Programs**

Buffalo State College	Degree	HEGIS	Curriculum Code	Jamestown Community College	Degree	HEGIS	Curriculum Code
Computer Information Systems	BS	0702	0825	Computer Information Systems	AAS	5103	0581
				Computer Science	AS	5101	0532
				Information Technology	AAS	5101	1492
Electrical Engineering Technology: Electronics	BS	0925	0821/0831	Engineering Science	AS	5609	0530
Electrical Engineering Technology: Smart Grid	BS	0925	0820/0830	Engineering Science	AS	5609	0530
Industrial Technology	BS	0925	0810	Mechanical Technology	AAS	5315	0595
Mechanical Engineering Technology	BS	0925	0822/0832	Mechanical Technology	AAS	5315	0595
Technology Education	BS	0839.01	0500	N/A	N/A		

	Undergraduate Graduation and Enrollment for Buffalo State College Technology Programs Within Scope of Study																							
	BSC Enrolled Total	CIS Grad	CIS FT	CIS PT	EETE Grad	EETE Enrolled Total	EETE FT	EETE PT	EETSG Grad	EETSG Enrolled Total	EETSG FT	EETSG PT	IT Grad	IT EnrolledT otal	IT FT	IT PT	MET Grad	MET Enrolled Total	MET FT	MET PT	TE Grad	TE Enrolled Total	TE FT	TE PT
Year	Total	Grad	FT	PT	Grad	Total	FT	PT	Grad	Total	FT	PT	Grad	total	FT	PT	Grad	Total	FT	PT	Grad	Total	FT	PT
2000	9,386	68	232	114	19	58	25	33	5	43	25	18	30	128	42	86	13	92	46	46	18	66	51	15
2001	9,590	83	281	114	15	60	32	28	4	43	24	19	27	114	39	75	17	99	58	41	10	74	60	14
2002	9,495	82	258	99	9	61	39	22	5	45	23	22	30	92	29	63	17	91	59	32	11	89	81	8
2003	9,003	70	258	79	10	55	33	22	5	41	24	17	21	90	42	48	22	82	48	34	14	92	82	10
2004	9,008	97	223	76	9	52	32	20	6	34	16	18	17	72	36	36	21	80	51	29	23	92	84	8
2005	9,010	94	183	60	7	56	40	16	4	31	16	15	24	62	25	37	3	89	54	35	16	89	77	12
2006	9,314	51	176	53	10	54	39	15	5	31	17	14	13	56	22	34	23	97	62	35	20	67	60	7
2007	9,139	45	179	59	10	70	48	22	10	29	21	8	12	56	24	32	11	109	82	27	24	56	51	5
2008	9,371	56	167	49	6	65	49	16	6	33	23	10	14	55	32	23	8	122	86	36	19	53	49	4
2009	9,821	51	165	45	7	71	54	17	8	34	27	7	17	56	28	28	12	133	103	30	11	57	55	2
2010	9,788	58	173	43	5	74	59	15	7	43	38	5	12	59	34	25	11	142	110	32	13	52	47	5
2011	10,002	53	175	36	13	73	57	16	7	47	33	14	17	69	27	42	22	142	100	42	13	46	38	8

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

BSC Technology Program-Vendor Certification Mapping				Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
1	All	Project Management Professional (PMP)	PMI	1984	Advanced	364,542	19 countries (38% outside U.S.)		Y	SS	Y							The standard industry-recognized certification for project managers. Globally recognized, the PMP demonstrates that certificants have the experience, education and competency to successfully lead and direct large projects.
2	All	Certified Associate in Project Management (CAPM)	PMI		Entry-level	~9,000			Y	SS								An entry-level certification for project practitioners. Designed for those with less project experience, the CAPM demonstrates certificants' understanding of the fundamental knowledge, terminology and processes of effective project management.
3	All	Program Management Professional (PgMP)	PMI		Advanced	~400												Certification for those with advanced experience and skill as program managers. The PgMP demonstrates certificants' competency to oversee multiple, related projects and their resources.
4	All	Scheduling Professional (PMI-SP)	PMI		Intermediate													Certification for a specialist role in project scheduling.
5	All	Risk Management Professional (PMI-RMP)	PMI		Intermediate													Certification that fills the need for a specialist role in project risk management.
6	All	Certified Cost Consultant (CCC)/Certified Cost Engineer (CCE)	AACE	1976	Advanced	1699	829		Y			Y		Y				Certification for specialists who meet a demanding set of engineering cost and management criteria through a rigorous examination, experience, education, and ethical qualifications.
7	All	Certified Cost Technician (CCT)	AACE		Intermediate	292	177											A certification that gives less experienced professionals the opportunity to advance their cost engineering skills and professional development.
8	All	Certified Estimating Professional (CEP)	AACE		Intermediate	137	14											Certification that establishes credentials for those individuals working in the engineering estimating field.
9	All	Project+	CompTIA		Intermediate													Certification for entire project life cycle from initiation and planning through execution, acceptance, support and closure. While not accredited, the U.S. Dept. of State recognizes Project+.
10	All	Associate Standards Professional (Astd)	SES	1985/2000	Entry-level													An entry-level certification that demonstrates a fundamental knowledge of standards and application.
11	All	Certified Standards Professional (CStd)	SES	1985/2000	Intermediate	35	5											Certification that demonstrates a thorough, more sophisticated knowledge of the principles, techniques and effects of standardization and based on experience, expertise and contributions in the area of standards. in four categories: standards development, standards application, standards management, and standards information.

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

BSC Technology Program-Vendor Certification Mapping				Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
12	Industrial Technology	Certified in Production and Inventory Management (CPIM)	APICS	1973	Intermediate	95,000		Y - Online through Fox Valley Technical College	Y								Y	Leading certification for supply chain management/production and inventory control that contains five modules: Supply chain management; resource planning; scheduling and planning; operations control; and resource strategic management.
13	Industrial Technology	Certified Supply Chain Professional (CSCP)	APICS	2005	Advanced	8,000			Y								Y	An expert-level certification that focuses on an end-to-end view of the supply chain with four modules: supply chain management; operations, planning and logistics; customer and supplier relationships; and information technology impact.
14	Industrial Technology	Certification in Transportation and Logistics (CTL)	APICS	1948	Advanced													Certification based on partnership between APICS and American Society of Transportation and Logistics (AST&L). Scope includes efficiency of supply chain operations; and development of analytical skills necessary to identify ways to improve transportation, supply chain, and logistical processes.
15	Industrial Technology	AutoCAD 2012 Certified Associate	Autodesk		Intermediate													Certification for industry-standard computer-aided drawing/manufacturing program.
16	Industrial Technology	AutoCAD 2012 Certified Professional	Autodesk		Advanced													Advanced certification for industry-standard computer-aided drawing/manufacturing program.
17	Industrial Technology	Certified (Senior) Technology Manager (CTM/CTSM)	ATMAE	1993	Intermediate-Senior	292	3											Broad-based certification in industrial technology production planning and control, safety, quality, management, and supervision.
18	Industrial Technology	Certified (Senior) Manufacturing Specialist (CMS/CSMS)	ATMAE	2009	Intermediate/Senior	70	1											Certification with emphasis on manufacturing joining, forming, and casting, machining, non-traditional machining, polymers, industrial materials, computer integrated manufacturing, production planning, quality; management & supervision, metrology, wood technology, technical drafting, manufacturing philosophies, and electronics.
19	Industrial Technology	Certified (Senior) Technical Professional (CTP / CSTP)	ATMAE	2010	Intermediate/Senior	6												Certification for graduates of both 2-year and 4-year programs. The certification is limited to technical programs without a management component that result in either an associate (AS, AAS) degree or a baccalaureate (BS, BA) degree.
20	Industrial Technology	Certified (Senior) Engineering Graphics (CEG/CSEG)	ATMAE		Intermediate/Senior													A certification for expression of industrial design ideas through engineering graphics, geometric construction, orthographic views, and standardized annotations used within the industrial enterprise in areas such as manufacturing process planning, quality control, purchasing, and other areas of expertise.

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

	BSC Technology Program-Vendor Certification Mapping			Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
21	Industrial Technology	Lean Bronze Certification	ASQ/SME, et al		Entry-level	111												Initial certification for lean principles and tools, and ability for tactical implementation that drives improvement and shows measurable results.
22	Industrial Technology	Lean Silver Certification	ASQ/SME, et al		Intermediate													Mid-level certification for lean project leader on value stream transformations.
23	Industrial Technology	Lean Gold Certification	ASQ/SME, et al		Advanced													Lean Gold Certification (the highest level of lean certification) recognizes all aspects of lean transformation across an entire enterprise. It represents your career progression to a point of influence and authority over assets, processes and people.
24	Industrial Technology	Certified Quality Engineer (CQE)	ASQ	1968	Intermediate	38,896		Y-RIT	Y									Certification for principles of product and service quality evaluation and control including development and operation of quality control systems, application and analysis of testing and inspection procedures, the ability to use metrology and statistical methods to diagnose and correct improper quality control practices, an understanding of human factors and motivation, facility with quality cost concepts and techniques, and the knowledge and ability to develop and administer management information systems and to audit quality systems for deficiency identification and correction.
25	Industrial Technology	Certified Quality Technician (CQT)	ASQ	1970	Intermediate	23,126		Y-RIT	Y									Certification for those who support quality engineers or supervisors, and solves quality problems, prepares inspection plans and instructions, selects sampling plan applications, prepares procedures, trains inspectors, performs audits, analyzes quality costs and other quality data, and applies fundamental statistical methods for process control.
26	Industrial Technology	Certified Quality Reliability Engineer (CRE)	ASQ	1972	Intermediate	4,735		Y-RIT	Y									Certification to improve product/systems safety, reliability and maintainability. Includes design review and control; prediction, estimation, and apportionment methodology; failure mode effects and analysis; the planning, operation and analysis of reliability testing and field failures, including mathematical modeling; understanding human factors in reliability; and the ability to develop and administer reliability information systems for failure analysis, design and performance improvement and reliability program management over the entire product life cycle.
27	Industrial Technology	Certified Quality Auditor (CQA)	ASQ	1987	Intermediate	36,149		Y-RIT	Y									Certification for the standards and principles of auditing and the auditing techniques of examining, questioning, evaluating and reporting to determine a quality system’s adequacy and deficiencies.

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

	BSC Technology Program-Vendor Certification Mapping			Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
28	Industrial Technology	Certified Manager of Quality/Organizational Excellence (CMQ/OE)	ASQ	1995	Intermediate	14,931		Y-RIT	Y									Certification for those who lead and champion process-improvement initiatives that can have regional or global focus in a variety of service and industrial settings.
29	Computer Information Systems	Certified Software Quality Engineer (CSQE)	ASQ	1996	Intermediate	5,093		Y-RIT	Y									Certification for software quality development and implementation, software inspection, testing, verification and validation; and implements software development and maintenance processes and methods.
30	Industrial Technology	Certified Quality Improvement Associate (CQIA)	ASQ	2000	Intermediate	7,652		Y-RIT	Y									Certification of quality tools and their uses and for those involved in quality improvement projects.
31	Industrial Technology	Certified Calibration Technician (CCT)	ASQ	2003	Intermediate	1,446		Y-RIT	Y									Certification for those that calibrate, maintain and repair electrical, mechanical, electromechanical, analytical and electronic measuring, recording and indicating instruments and equipment for conformance to established standards.
32	Industrial Technology	Certified Quality Process Analyst (CQPA)	ASQ	2005	Intermediate	1,049		Y-RIT	Y									Certification for those who support quality engineers and analyzes and solves quality problems and is involved in quality improvement projects. A Certified Quality Process Analyst may be a recent graduate or someone with work experience who wants to demonstrate his or her knowledge of quality tools and processes.
33	Industrial Technology	Certified Six Sigma Green Belt (CSSGB)	ASQ	2006	Entry-level	6,415		Y-RIT	Y									Six Sigma Green Belt certification operates in support of or under the supervision of a Six Sigma Black Belt, analyzes and solves quality problems and is involved in quality improvement projects, tools and processes.
34	Industrial Technology	Certified Six Sigma Black Belt (CSSBB)	ASQ	2001	Advanced	11,528		Y-RIT	Y	SS?								The Six Sigma Black Belt certification is a professional who can explain Six Sigma philosophies and principles, including supporting systems and have a thorough understanding of all aspects of the DMAIC model in accordance with Six Sigma principles.
35	Industrial Technology	Certified Master Black Belt (CMBB)	ASQ	2009	Advanced	22		Y-RIT	Y									Certification is a mark of career excellence and aimed at individuals who possess exceptional expertise and knowledge of current industry practice and have outstanding leadership ability, are innovative, and demonstrate a strong commitment to the practice and advancement of quality and improvement.
36	Industrial Technology	Certified Safety Professional (CSP)	BCSP	1969	Intermediate	12637	236		Y		Y					Y		"Gold" safety certification that demonstrates mastery of the core knowledge required for professional safety practice.
37	Industrial Technology	Associate Safety Professional (ASP)	BCSP		Intermediate	1038			Y		Y							Entry-level certification, first step towards achieving the Certified Safety Professional (CSP) certification.
38	Industrial Technology	Graduate Safety Practitioner (GSP)	BCSP		Advanced	962		Y	Y		Y							Certification available to safety degree graduates from degree programs which meet BCSP Qualified Academic Program standards. The GSP program is an alternate path to the Certified Safety Professional (CSP).

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

BSC Technology Program-Vendor Certification Mapping				Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
39	Industrial Technology	Certified Plant Engineer (CPE) Category A	AFE		Intermediate													Certification establishes standard of knowledge for all plant engineers and includes: Electrical Engineering, Mechanical Engineering, Civil Engineering, OSHA, HVAC, and Economics/Management.
40	Industrial Technology	Certified Plant Engineer (CPE) Category B	AFE		Intermediate													Certification establishes standard of knowledge for all plant engineers and includes: Electrical Engineering, Mechanical Engineering, Civil Engineering, OSHA, HVAC, and Economics/Management.
41	Industrial Technology	Certified Plant Maintenance Manager (CPMM)	AFE		Intermediate													Certification for Computerized Maintenance, Investment Returns, and Total Productive Management and similar topics. The CPMM shows mastery of current teachings and a desire to learn as new methods are developed.
42	Industrial Technology	Certified Plant Supervisor (CPS)	AFE		Intermediate													A certification appropriate for plant supervisors that demonstrates their knowledge to execute and manage any situation that comes their way.
43	Industrial Technology	Certified Manufacturing Technologist (CMfgT)	SME		Intermediate													Certification for new manufacturing engineers and experienced manufacturers without other credentials.
44	Industrial Technology	Certified Manufacturing Engineer (CMfgE)	SME		Advanced	12,000												Certification for those who demonstrate a comprehensive knowledge of manufacturing processes and practices.
45	Industrial Technology	Six Sigma Black Belt Certification	SME & ASU		Advanced			Y	Y									Certification of the DMAIC process and the tools used to achieve effective process and product improvement and understand how lean principles and design for Six Sigma fit into the overall task of product and process improvement.
46	Industrial Technology	Six Sigma Green Belt Certification	SME & ASU		Intermediate			Y	Y									Green Belts are able to quantify the current state of a process, assess the capability of a measurement system, perform data analysis, and stratify output variables into potential sources of variation. A key objective is to reduce defects or errors to increase demand and customer satisfaction, and data analysis driving product quality and reliability.
47	Industrial Technology	Green Manufacturing Specialist Certificate	SME & PU		Intermediate			Y	Y									A certification created through a partnership of SME along with the Purdue University Technical Assistance Program (TAP) for proficiency in the environmentally friendly green manufacturing outcome assessment.
48	Industrial Technology	Engineering Management Certificate	IIE	1998	Intermediate	N/A	15%	Y	Y									Certification for mastery of basic management skills necessary for leading engineering teams, departments and organizations.
49	Industrial Technology	Industrial Engineering Professional Skills Certification	IIE	1998	Intermediate	N/A	15%	Y	Y									Certification for the basics of the industrial engineering toolbox and fundamental management skills required for demanding tasks in the industry.

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

BSC Technology Program-Vendor Certification Mapping				Certification Characteristics				Certification Integration/Accreditation										
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description
50	Industrial Technology	Lean Enterprise Certificatation	IIE	1998	Intermediate													Certification based on a series of seminars to transform a company into a lean enterprise: Lean Green Belt; Six Sigma Yellow Belt; Transforming Your Organization.
51	Industrial Technology	Lean and Six Sigma Facilitator Certificate	IIE		Intermediate													Certification for the knowledge and skills to facilitate transformation in office, service and technology-based organizations.
52	Industrial Technology	Six Sigma Green Belt Certification	IIE	1998	Intermediate	N/A	15%											Introductory certification to provide thorough understanding of Six Sigma and its focus on eliminating defects through fundamental process knowledge.
53	Industrial Technology	Six Sigma Black Belt Certification	IIE	1998	Advanced	N/A	15%		Y	Y								Advanced certification to measure a process, analyze the results, develop process improvements and quantify the resulting savings.
54	Industrial Technology	Enterprise Risk Manager Certification	IIE	1998	Intermediate	N/A	15%	Y										Certification based on the new families of ISO, ANSI and NIST standards dealing with risk management and responds to new federal regulatory requirements dealing with public safety.
55	Industrial Technology	Certified Automation Professional (CAP)	ISA	2004	Intermediate													Certification for those who are responsible for the direction, definition, design, development/application, deployment, documentation, and support of systems, software, and equipment used in control systems, manufacturing information systems, systems integration, and operational consulting.
56	Industrial Technology	Certified Control Systems Technician Program (CCST)	ISA	1995	Intermediate	4,000												Certification for technicians' knowledge and skills in automation and control.
57	Industrial Technology	Certified Professional in Supply Management (CPSM)	ISM	2008	Intermediate													Certification of international scope in areas such as finance, supplier relationship management, organizational global strategy and risk compliance. Designed to boost the effectiveness of a Bachelor's degree and practical work experience.
58	Industrial Technology	Certified Production Technician (CPT)	MSSC		Intermediate			Y - BPS										Certification that encompasses four production modules: Safety; Quality Practices & Measurement; Manufacturing Processes & Production; and Maintenance Awareness
59	Industrial Technology	Certified Logistics Associate (CLA)	MSSC		Entry-level			Y - BPS										Foundation-level certification addresses the core competencies of higher skilled, front-line material handling workers (entry-level to first line of supervision) across the supply chain: from factories, to warehouses, to distribution centers to transporters.
60	Industrial Technology	Certified Logistics Technician (CLT)	MSSC		Intermediate													Mid-level certification addresses the core competencies of higher skilled, front-line material handling workers (entry-level to first line of supervision) across the supply chain: from factories, to warehouses, to distribution centers to transporters.



**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

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61	Industrial Technology	Mastercam Associate Level (CNC) Certification	CNC	2001	Intermediate	300	10	Y - Advisory committee	Y						Y*			Certification of skills and knowledge in the use of Mastercam Software.
62	Industrial Technology	Mastercam Professional Level (CNC) Certification	CNC	2001	Advanced			Y - Advisory committee	Y						Y*			Advanced certification of skills, knowledge, and the application of Mastercam functionality within a set amount of time.
63	Industrial Technology	Mastercam End User Certification	CNC	2001	Intermediate			Y - Advisory committee	Y						Y*			Certification of CNC knowledge, ability to program and cut quality parts.
64	Industrial Technology	Certified Associate in Materials Handling (CAMH)	MHMS	mid-1980s	Intermediate													Certification for material handling fundamentals and general equipment knowledge.
65	Industrial Technology	Professional Certified in Materials Handling (PCMH)	MHMS	mid-1980s	Advanced													Certification for detailed planning, design and equipment application knowledge and analytical capability.
66	Electrical Engineering Technology: Electronics	Associate Certified Electronics Technician (CETa)	ETA-I	1965	Intermediate	> 100,000	A few hundred; the majority are in the U.S.	Y - ECC	Y				Y					Certification for technicians who have less than two years experience or trade school training for electronics technicians. Once a technician has completed the two year program they should also take a journeyman option. There are other journeyman, master and senior level certifications that follow.
67	Electrical Engineering Technology: Electronics	Certified Journeyman Electronics Technician (CET)	ETA-I	1970s	Intermediate				Y				Y					Journeyman certifications are available in the following specialist areas: biomedical, communications, computers, and other.
68	Electrical Engineering Technology: Electronics	Senior Certified Electronics Technician (CETsr)	ETA-I		Advanced	A few thousand												Senior level certification for professional electronics service technicians, technician-managers, consultants, and electronics educators who have been active in the industry for six or more years.
69	Electrical Engineering Technology: Electronics	Master Certified Electronics Technician (CETma)	ETA-I		Intermediate	370												Master certification for technicians who are able to demonstrate proficiency in the many fields of electronics.
70	Electrical Engineering Technology: Electronics	Telecommunications Certification	iNARTE	1982	Entry-level	1812	77											A certification for professionals practicing a wide range of telecommunications disciplines, including photonic systems, PCS/PCN, cellular, satellite, LAN, WAN and many more. Three different levels within the certification from beginner to master.
71	Electrical Engineering Technology: Electronics	Unlicensed Wireless Systems Installation Wireless Certification	iNARTE		Advanced													A certification which distinguishes from marginally to fully qualified design and installation personnel for wireless systems which do not require a license from the FCC.
72	Electrical Engineering Technology: Electronics	Electromagnetic Compatibility (EMC/EMI) Certification	iNARTE	1988	Advanced	1901	910		Y				Y					A certification for professional engineers and technicians practicing in EMC fields to include bonding, shielding, grounding, EMI prediction, EMI analysis, conducted and radiated interference, lightning protection and more.
73	Electrical Engineering Technology: Electronics	Electromagnetic Compatibility (EMC) Design Engineer Certification	iNARTE	2011	Advanced	0	0											A certification for those with less than three years experience and are responsible for product design in a U.S. company with manufacturing in lower cost regions outside the U.S.

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74	Electrical Engineering Technology: Electronics	Electrostatic Discharge Control (ESD) Certification	iNARTE	1999	Advanced	311	45		Y				Y					A certification for engineers and technicians whose training and experience have primarily focused on problems, engineering design and corrective measures associated with minimizing or eliminating electrostatic discharge.
75	Electrical Engineering Technology: Electronics	Product Safety (PS) Certification	iNARTE	2004	Advanced	375	167											A certification that focuses on engineering and practice to reduce types of risk to persons, animals and property that have to be covered by a formal hazard analysis to meet the requirements of the relevant legislation. The ability to effectively manage product safety in design, manufacture, installation and operational use is a mandatory requirement of all world-wide product safety legislation.
76	Electrical Engineering Technology: Electronics	Associate Certified Electronics Technician (ACET)	ISCET		Intermediate													An entry-level certification that encompasses the basic electronics portion of the full credit CET certification exam.
77	Electrical Engineering Technology: Electronics	Journeyman Level Certified Electronics Technician (CET)	ISCET	1965	Intermediate	50,000												Certification in journeyman specialization in one of the following: consumer, industrial, communications, computer, medical, or radar.
78	Electrical Engineering Technology: Electronics	Certified Electronics Systems Associate (ESA)	ISCET		Intermediate													Certification that offers advantages above the Associate level CET program. The ESA certification covers DC, AC, Semi and Digital in four parts.
79	Electrical Engineering Technology: Electronics	Certified Biometrics Professional (CBP)	IEEE		Intermediate													Certification for those with the knowledge and skills necessary to apply the biometrics professional body-of-knowledge to real-world problems and situations.
80	Electrical Engineering Technology: Electronics	Certified Technologist	NICET		Intermediate	260	0	Y										Certification for those with a Bachelor'ss Degree in an engineering technology program accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology.
81	Electrical Engineering Technology: Electronics	Electrical Testing Certification	NICET		Intermediate													Certification program for technicians who are engaged in inspection, testing, and periodic maintenance of electrical power equipment, and evaluation of such equipment for acceptance for service, continued serviceability, or required maintenance.
82	Electrical Engineering Technology: Smart Grid	Certified Power Quality Professional (CPQ)	AEE		Intermediate	247												A certification designed for power quality professionals who have demonstrated a high level of knowledge, experience, competence and ethical fitness in this emerging, highly specialized field.
83	Electrical Engineering Technology: Smart Grid	Certified Lighting Efficiency Professional (CLP)	AEE		Intermediate	329												Certification for professionals who have distinguished themselves as leaders in the field of lighting efficiency.
84	Technology: Smart Grid	Certified Energy Manager (CEM)	AEE	1981	Intermediate	10373												Certification for energy master professionals.
85	Electrical Engineering Technology: Smart Grid	Energy Manager in Training (EMIT)	AEE		Intermediate	400												Entry-level certification for those that pass the Certified Energy Manager exam but do not have the necessary additional credentials.

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86	Mechanical Engineering	Certified Apprentice Drafter	ADDA		Intermediate			Y										International certification for apprentice drafters, drafters, designers, design drafters, design technicians, engineering and architectural technicians and digital imaging technicians, as well as other graphic professionals to indicate their knowledge in professional concepts and internationally recognized standards and practices.
87	Mechanical Engineering	Certified Drafter	ADDA		Intermediate			Y										International certification programs for drafters, drafters, designers, design drafters, design technicians, engineering and architectural technicians and digital imaging technicians, as well as other graphic professionals to indicate their knowledge in professional concepts and internationally recognized standards and practices.
88	Mechanical Engineering	Certified Quality Inspector (CQI) (formerly Certified Mechanical Inspector)	ASQ	1984	Intermediate													Certification for those who are under the direction of quality engineers, supervisors, or technicians, can use the proven techniques to hardware documentation, performs laboratory procedures, inspects products, measures process performance, records data and prepares formal reports.
89	Mechanical Engineering	Industrial Instrumentation Certification	NICET		Intermediate													Certification designed for engineering technicians who are engaged in a combination of the following instrumentation system activities: design assistance, installation and maintenance of industrial measurement and control systems, and the installation and maintenance of a variety of electrical, electronic, and pneumatic instruments used within systemsindustrial measurement and control systems, and the installation and maintenance of a variety of electrical, electronic, and pneumatic instruments used within systems.
90	Mechanical Engineering	Associate Engineering Manager (AEM)	ASEM & SME		Intermediate			Y	Y									Certification for technical professionals seeking to establish credentials in preparation for early technical management or supervisory assignments. Entry point to PEM certification.
91	Mechanical Engineering	Professional Engineering Manager (PEM)	ASEM & SME		Advanced			Y	Y									Certification designed for experienced technical managers seeking to validate their skills and experience with a professional certification.
92	Mechanical Engineering	Y14.5 Geometric Dimensioning and Tolerancing Technologist Certification	ASME	1997	Intermediate	475	17%											Certification provides the means to recognize proficiency in the understanding and application of the geometric dimensioning and tolerancing (GD&T) principles expressed in the ASME Y14.5 Standard.
93	Mechanical Engineering	Y14.5 Geometric Dimensioning and Tolerancing Professional Certification	ASME	1997	Advanced	560	17%											Advanced certification provides the means to recognize proficiency in the understanding and application of the geometric dimensioning and tolerancing (GD&T) principles expressed in the ASME Y14.5 Standard.

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94	Mechanical Engineering	Certified Quality Analyst (CQA)	CQL	1987	Intermediate													Certification to demonstrate mastery of gathering, analyzing and presenting data to improve quality of services.
95	Mechanical Engineering	Certified Technologist	NICET		Intermediate	260												A certification for those with a Bachelors Degree in an engineering technology program accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET).
96	Mechanical Engineering	Certified Value Specialist (CVS)	SAVE		Intermediate													A certification for those whose principal career is value engineering.
97	Mechanical Engineering	Associate Value Specialist (AVS)	SAVE		Intermediate													An entry-level certification that recognizes those individuals who decided to become professional value engineers but who have not yet acquired all the experience or technical skills expected of a Certified Value Specialist.
98	Mechanical Engineering	Value Methodology Practitioner (VMP)	SAVE		Intermediate													Certification that recognizes those individuals who acquired the basic skills of value engineering/analysis but their principal career is not value engineering.
99	Technology Education	Career and Technical Education/Early Adolescence through Young Adulthood	NBPTS		Intermediate													Certification for teachers who teach career and technical information subjects to students ages 11-18+ and are focused on a specialty area including Agriculture and Environmental Sciences; Business, Marketing, Information Management, and Entrepreneurship; Family and Consumer Sciences; Health Services; Human Services; Manufacturing and Engineering Technology; and Technology Education.
100	Computer Information Systems	Cisco Certified Architect (CCA)	Cisco		Advanced			Y	Y									Prestigious credential recognizes the architectural expertise of network designers who can support the increasingly complex networks of global organizations and effectively translate business strategies into evolutionary technical strategies.
101	Computer Information Systems	Cisco Certified Internetwork Expert (CCIE)	Cisco	1993	Expert	20450 - 2008		Y	Y									Certification accepted worldwide as the most prestigious networking certification in the industry. Certification available in several specific disciplines including Routing & Switching, Security, Service Provider, Service Provider Operations, Storage Networking, Voice, and Wireless
102	Computer Information Systems	Cisco Certified Design Expert (CCDE)	Cisco		Expert			Y	Y									Certification intended for professionals who have day-to-day responsibility for designing complex, converged IP networks. Candidates are strongly encourage to have at least seven years of networking experience and a thorough understanding of network infrastructure principles and design topics.
103	Computer Information Systems	Cisco Certified Design Professional (CCDP)	Cisco		Advanced (Professional)			Y	Y									Certification that validates advanced knowledge of network design concepts and principles.

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104	Computer Information Systems	Cisco Certified Internetwork Professional (CCIP)	Cisco		Advanced (Professional)			Y	Y									Certification that validates advanced knowledge and skills required to manage service provider infrastructures.
105	Computer Information Systems	Cisco Certified Network Professional (CCNP)	Cisco		Advanced (Professional)	50,000		Y	Y									Certification that validates the ability to plan, implement, verify and troubleshoot local and wide-area enterprise networks and work collaboratively with specialists on advanced security, voice, wireless and video solutions. Certification also available in various disciplines including Security, Service Provider Operations, Voice, and Wireless.
106	Computer Information Systems	Cisco Certified Entry Networking Technician (CCENT)	Cisco		Entry-level			Y	Y									Certification that validates the ability to install, operate and troubleshoot a small enterprise branch network, including basic network security. Somewhat similar to CompTIA Network+ certification. CCENT is first exam for Cisco CCNA.
107	Computer Information Systems	Cisco Certified Network Associate (CCNA)	Cisco		Intermediate (Associate)	100,000		Y	Y	SS								Certification that validates the ability to install, configure, operate, and troubleshoot medium-size route and switched networks, including implementation and verification of connections to remote sites in a WAN. Certification also available in various disciplines including Security, Service Provider Operations, Voice, and Wireless.
108	Computer Information Systems	Cisco Certified Design Associate (CCDA)	Cisco		Intermediate (Associate)			Y	Y									Certification validates knowledge required to design a Cisco converged network.
109	Computer Information Systems	Advanced Security Practitioner (CASP)	CompTIA	2011	Advanced				Y		Y							Certification for enterprise security; risk management; research and analysis; and integration of computing, communications, and business disciplines; designed to follow Security+ certification.
110	Computer Information Systems	A+	CompTIA	1993	Entry-level	700,000		Y - ECC	Y	SS,LT	Y							Certification proves competence in areas such as installation, preventative maintenance, networking, security and troubleshooting.
111	Computer Information Systems	CDIA+ (Document Imaging Solutions Sellers)	CompTIA		Intermediate													Certification that tests expertise in the technologies and best practices used to plan, design, and specify a document imaging management system.
112	Computer Information Systems	CTP+ (Network Convergence)	CompTIA		Intermediate													Certification that validates the core knowledge and skills IT professionals need to sell and service convergent technologies.
113	Computer Information Systems	CTT+ (Technical Instructors)	CompTIA		Advanced													Certification that covers core instructor skills, including preparation, presentation, communication, facilitation and evaluation in both a classroom and virtual classroom environment.

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114	Computer Information Systems	Linux+	CompTIA	2010	Entry-level			Y	Y									Certification for those who work at the Linux command line, perform maintenance tasks, assist users, and install and configure workstations. This certification is the result of a partnership between CompTIA and the Linux Professional Institute (LPI), the world's leading Linux certification organization and is a stepping stone to vendor-specific training, such as Oracle Certified Associate and Novell SUSE Linux programs.
115	Computer Information Systems	Network+	CompTIA	1999	Intermediate	235,000			Y	SS	Y							Certification that proves a technician’s competency in managing, maintaining, troubleshooting, installing and configuring basic network infrastructure. Similar to Cisco CCENT certification.
116	Computer Information Systems	PDI+ (Printer and Document Imaging)	CompTIA		Intermediate													Certification is recognized by several industry leaders, including Canon, Sharp and Xerox, as a benchmark certification for professionals that service and support document imaging devices.
117	Computer Information Systems	Security+	CompTIA	2002	Entry-level				Y	SS,LT	Y							Certification that proves competency in system security, network infrastructure, access control and organizational security.
118	Computer Information Systems	Server+	CompTIA	2001	Intermediate			Y	y									Certification for technical support professionals with 18 to 24 months of IT experience.
119	Computer Information Systems	Storage+	CompTIA	2011	Intermediate													Certification created in partnership with nonprofit Storage Networking Industry Association for storage professionals required to configure basic networks to include archive, backup, and restoration technologies.
120	Computer Information Systems	Cloud Essentials	CompTIA	2011	Intermediate													Certification that demonstrates an individual knows what cloud computing means from a business and technical perspective, as well as what is involved in moving to and governing the cloud.
121	Computer Information Systems	Green IT	CompTIA	2011	Intermediate													Certification for professionals who must implement environmentally sound techniques within an organization's IT infrastructure. The certification enhances existing IT credentials to incorporate emerging technologies that shape the global green IT industry. Requires A+ or Server+ certifications as prerequisites.
122	Computer Information Systems	Healthcare IT Technician	CompTIA	2011	Intermediate													Certification for professionals who must implement, deploy, and support healthcare IT systems in various clinical settings.
123	Computer Information Systems	IT for Sales	CompTIA	2011	Intermediate													Certifications for professionals who must possess knowledge in technology to complete sales activities with customers in technical fields.
124	Computer Information Systems	Strata IT Fundamentals	CompTIA		Entry-level													Entry-level certification for those who require a knowledge of PC components, functionality, compatibility and related technology topics. Two certification tracts exist: PC functionality and PC technology.

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125	Computer Information Systems	Systems Security Certified Practitioner (SSCP)	(ISC)2		Intermediate	1135			Y		Y							Certification for those who are Network Security Engineers, Security Systems Analysts, or Security Administrators. Also appropriate for those in many other non-security disciplines that require an understanding of security but do not have information security as a primary part of their job.
126	Computer Information Systems	Certified Authorization Professional (CAP)	(ISC)2		Advanced	910			Y		Y							Certification for those responsible for formalizing processes used to assess risk and establish security requirements and documentation.
127	Computer Information Systems	Certified Secure Software Lifecycle Professional (CSSLP)	(ISC)2		Advanced	944			Y		Y							Certification that ensures security is considered throughout the entire lifecycle.
128	Computer Information Systems	Certified Information Systems Security Professional (CISSP)	(ISC)2		Advanced	73247			Y	SS	Y							Certification for professionals who develop policies and procedures in information security.
129	Computer Information Systems	Information Systems Security Architecture Professional (ISSAP)	(ISC)2		Expert	939			Y		Y							Certification for Chief Security Architects and Analysts whowork as independent consultants or in similar capacities.
130	Computer Information Systems	Information Systems Security Engineering Professional (ISSEP)	(ISC)2		Advanced	705												Certification developed in conjunction with the U.S. National Security Agency for systems security engineering professionals. Also appropriate for those incorporating security into projects, applications, business processes, and all information systems.
131	Computer Information Systems	Information Systems Security Management Professional (ISSMP)	(ISC)2		Advanced	706			Y		Y							Certification that incorporates managerial elements such as project management, risk management, delivering a security awareness program, and managing a business continuity planning program.
132	Computer Information Systems	ITIL Version 3 Foundation Certificate in IT Service Management	APMG		Entry-level	53622			Y	SS,LT								Certification that provides general awareness of the key elements, concepts and terminology used in the ITIL Service Lifecycle, including the linkages between Lifecycle stages, the processes used and their contribution to Service Management practices.
133	Computer Information Systems	ITIL Version 3 Service Lifecycle Intermediate Qualification: Service Strategy	APMG		Intermediate				Y	LT								Certification to leverage the service lifecycle as a strategic asset to design, develop and implement ITIL service management.
134	Computer Information Systems	ITIL Version 3 Service Lifecycle Intermediate Qualification: Service Design	APMG		Intermediate				Y	LT								Certification to design services and govern practices, policies and procedures to facilitate the introduction of services, thereby ensuring quality service delivery, customer satisfaction and cost-effective service provision.
135	Computer Information Systems	ITIL Version 3 Service Lifecycle Intermediate Qualification: Service Transition	APMG		Intermediate				Y	LT								Certification to transition new and changed services into operations, ensuring that requirements are effectively realized while controlling the risks of failure and disruption.
136	Computer Information Systems	ITIL Version 3 Service Lifecycle Intermediate Qualification: Service Operation	APMG		Intermediate				Y	LT								Certification for efficient delivery and support of key services and to ensure fair value for the customer and service provider.

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137	Computer Information Systems	ITIL Version 3 Service Lifecycle Intermediate Qualification: Continual Service Improvement	APMG		Intermediate				Y	LT								Certification focuses on implementation of Continual Service Improvement best practices enabling IT departments to create and maintain value for customers through better design, introduction and operation of services.
138	Computer Information Systems	ITIL Version 3 Service Capability Intermediate Qualification: Service Offerings and Agreements	APMG		Intermediate				Y	LT								Certification to ensure high levels of customer satisfaction by integrating demand and supplier management with the service portfolio and service catalog.
139	Computer Information Systems	ITIL Version 3 Service Capability Intermediate Qualification: Release, Control and Validation	APMG		Intermediate				Y	LT								Certification to learn how to implement new services in a controlled and cost-effective manner and release, control and validation best practices.
140	Computer Information Systems	ITIL Version 3 Service Capability Intermediate Qualification: Operational Support and Analysis	APMG		Intermediate				Y	LT								Certification for best practices to enable IT departments to reduce downtime and costs while improving customer satisfaction.
141	Computer Information Systems	ITIL Version 3 Service Capability Intermediate Qualification: Planning, Protection and Optimization	APMG		Intermediate				Y	LT								Certification that focuses on a deep level of understanding of ITIL processes and roles, how they are implemented and how they interact.
142	Computer Information Systems	ITIL Version 3: Managing Across the Lifecycle	APMG		Advanced				Y	LT								Advanced, capstone certification that focuses on the ancillary knowledge required to implement and manage the necessary skills in IT Service Management.
143	Computer Information Systems	ITIL Version 3: Expert	APMG		Advanced				Y	LT								Certification demonstrating superior knowledge of ITIL.
144	Systems	ITIL Version 3: Master	APMG		Advanced													Senior ITIL certification.
145	Computer Information Systems	Junior Level Linux Professional (LPIC-1)	LPI	2000	Entry-level			Y - Cuesta CC	Y								Y	Initial LINUX certification that includes how to work at the Linux command line, perform easy maintenance tasks: help out users, add users to a larger system, backup & restore, shutdown & reboot, install and configure a workstation (including X) and connect it to a LAN, or a stand-alone PC via modem to the Internet.
146	Computer Information Systems	Advanced Level Linux Professional (LPIC-2)	LPI	2001	Intermediate													Intermediate LINUX certification that includes administer a small to medium-sized site, plan, implement, maintain, keep consistent, secure, and troubleshoot a small mixed (MS, Linux) network, including a: LAN server (samba), Internet Gateway (firewall, proxy, mail, news), Internet Server (webserver, FTP server), supervise assistants, advise management on automation and purchases.
147	Computer Information Systems	Senior Level Linux Professional (LPIC-3)	LPI		Advanced													Certification for enterprise-level Linux professional and represents the highest level of professional, distribution-neutral Linux certification within the industry.
148	Computer Information Systems	Microsoft Certified Technology Specialist (MCTS)	MS		Intermediate				Y	Y								Certification for IT professionals to target specific Microsoft technologies and to distinguish themselves by demonstrating in-depth knowledge and expertise.



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149	Computer Information Systems	Microsoft Certified IT Professional (MCITP)	MS	2007	Advanced				Y	Y	Y							Certification that validates skills necessary to perform a particular technical job role, such as database administrator or enterprise messaging administrator. MCITP certifications build on the technical proficiency measured in the Microsoft Certified Technology Specialist (MCTS) certifications.	
150	Computer Information Systems	Microsoft Certified Desktop Support Technician (MCDST)	MS		Entry-level				Y	SS	Y							Certification for Windows XP that validates the set of skills required to succeed in a variety of job roles, such as help desk technician, customer support representative, computer support specialist, technical support representative, and technical support specialist.	
151	Computer Information Systems	Microsoft Certified Solutions Associate (MCSA)	MS	2012	Intermediate				Y	Y,SS	Y							Certification to validate the core technical skills required to build a sustainable career in IT; a requirement for MCSE certifications. Previous versions of this certification were called Microsoft Certified Systems Administrator and demonstrated the ability to administrate network and systems environments running Windows Sever 2003 (and earlier). Accreditations are for earlier MCSA certification.	
152	Computer Information Systems	Microsoft Certified Database Administrator (MCDBA)	MS		Intermediate				Y	Y	Y							Certification for those who derive physical database designs, develop logical data models, create physical databases, create data services by using Transact-SQL, manage and maintain databases, configure and manage security, monitor and optimize databases, and install and configure Microsoft SQL Server.	
153	Computer Information Systems	Microsoft Certified Solutions Expert (MCSE)	MS	2012	Intermediate				Y	Y-Ser	Y							Certifications designed to recognize IT professionals who can design and build solutions across multiple technologies, both on-premise and in the cloud. Previous versions of this certification were called Microsoft Certified Systems Engineer and demonstrated the ability to design and implement Windows Sever 2003 (and earlier) infrastructures. Accreditations are for earlier MCSE certification.	
154	Computer Information Systems	Microsoft Technology Associate (MTA)	MS	2010	Entry-level			Y	Y									Certification to validate fundamental knowledge of computer technology for students planning or starting a career in computer technology. MTA exams are available only to and through accredited academic institutions.	
155	Computer Information Systems	Microsoft Certified Professional Developer (MCPD)	MS		Advanced													Certification validates a comprehensive set of skills that are necessary to deploy, build, optimize, and operate applications successfully by using Microsoft Visual Studio and the Microsoft .NET Framework. Valid for two years.	
156	Computer Information Systems	Microsoft Certified Application Developer (MCAD)	MS		Intermediate				Y		Y							Certification that enables developers to show they can successfully implement functional specifications and build, deploy, and maintain Windows and web applications.	

**Professional Certifications Relevant to Buffalo State College Applied Technology Programs Within Scope of Study.**

BSC Technology Program-Vendor Certification Mapping				Certification Characteristics				Certification Integration/Accreditation											
Item	Buffalo State College Program	Professional Certification	Vendor Short Name	Year created	Level	Total Cert. Holders	Cert. Holders outside of U.S.	College or/High-School Integration	Any	ACE	ANSI	CESB	ICAC	ICEC	NIMS	NCCA/ICE	NCCRS	Description	
157	Computer Information Systems	Microsoft Certified Solution Developer (MCS D)	MS		Intermediate				Y		Y							Certification to design and develop enterprise solutions by using Microsoft .NET Framework 1.0 and .NET Framework 1.1, as well as Microsoft development tools and technologies.	
158	Computer Information Systems	Microsoft Certified Solutions Master (MCSM)	MS		Advanced													Microsoft Certified Solutions Master (MCSM) recognize the most experienced IT professionals who demonstrate and validate their deep technical skills to successfully design and implement technical solutions in a complex business environment.	
159	Computer Information Systems	Microsoft Certified Architect (MCA)	MS		Intermediate													Certification that enables the highest-achieving professionals in IT architecture to distinguish their expertise.	
160	Computer Information Systems	Microsoft Office Specialist (MOS)	MS		Entry-level				Y	Y								Certification on Microsoft Office programs and Windows operating systems. ACE accreditation is available for Office 2002, 2003 and 2007. It will be available for Office 2010 in January 2012.	
161	Computer Information Systems	Microsoft Certified Trainer (MCT)	MS		Expert				Y		Y							Certification for Microsoft Certified Trainers, the premier technical and instructional experts on Microsoft technologies, the only individuals authorized to deliver training for Microsoft certifications.	
162	Computer Information Systems	Certified Novell Administrator (CNA)	Novell		Intermediate													Certification for those who provide support for Novell software users in various work environments. There are two learning paths for the CNA certification: Novell Open Enterprise Server for NetWare and NetWare 6.	
163	Computer Information Systems	Certified Novell Engineer (CNE)	Novell	1987	Advanced													Certification for those who are responsible for keeping a computer network running efficiently and those involved in planning, installation, configuration, troubleshooting and upgrade services for networks. There are two separate paths for obtaining the CNE certification: CNE in Novell Open Enterprise Server for NetWare and CNE in Netware 6.	
164	Computer Information Systems	Novell Certified Linux Administrator (CLA)	Novell		Entry-level													A certification based on an international partnership created in 2010 between Novell and the Linux Professional Institute to standardize their entry-level Linux certification programs on LPIC-1.	
165	Computer Information Systems	Novell Certified Linux Engineer (CLE)	Novell		Advanced													The third and final certification in Novell's Linux Certification Path. Certificants must show "engineer level" knowledge of the Linux operating system including Network Services and Security.	
166	Computer Information Systems	Novell Certified Linux Professional (CLP)	Novell		Intermediate													The Certified Linux Professional 11 certification validates the skills necessary for performing administrative tasks on SUSE Linux Enterprise Server 11 platforms.	

## Appendix Six

### Professional Certification Organizations Questionnaire

#### *Organizational Information*

What is your organization name, address and contact information?

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---

What year did your organization first begin offering certifications?

---

What certifications do you offer?

---

Does your organization have any partnerships with secondary (high-school) or college institutions?

☐ Yes

☐ No

If yes, can you provide a list of partner institutions?

Does your organization have a list of published certification holders that is publicly available, or an outreach mechanism such as user forums?

#### *Certification Characteristics*

For each certification that you offer, please provide the following:

- Year created \_\_\_\_\_
- What is length of time that certification is valid?

- What are the continuing education requirements of the certification?
- How many certification holders are there for the certification?
- How many certification holders are from outside the United States?

*Certification Integration/Accreditation*

- Does the certification integrate with secondary (high-school) or college curriculums?  
☐ Yes  
If yes, can you provide a list of institutions that provide integration?  
☐ No
- Has the certification been accredited by the American National Standards Institute (ANSI)?  
☐ Yes  
☐ No
- Has the certification been evaluated for college credit equivalency by the American Council on Education (ACE)?  
☐ Yes  
☐ No
- Has the certification been accredited by the Council of Engineering and Scientific Specialty Boards (CESB)?  
☐ Yes  
☐ No
- Has the certification been accredited by the International Cost Engineering Council (ICEC)?

☐ Yes

☐ No

- Has the certification been accredited by any other nationally-recognized independent institution?

☐ Yes

If yes, please provide name of institution \_\_\_\_\_

☐ No

*Certification Eligibility/Requirements*

- Is a college degree and/or experience level required for certification?

☐ Yes

If yes, what are the educational or experiential requirements?

---

☐ No

*Exam Characteristics*

- Difficulty level:

☐ beginner

☐ medium

☐ advanced

- How many exams required? \_\_\_\_\_

- Are exam dates fixed or flexible?

☐ fixed

☐ flexible

- What is the approximate cost of the exam(s)? \_\_\_\_\_

- Does the certification exam use computer-based adaptive testing?

☐ Yes

☐ No

- Does the certification exam use computer-based performance-based testing?

☐ Yes

☐ No

- Does the certification exam use multiple choice?

☐ Yes

☐ No

- Does the certification exam use any other format?

☐ Yes

If yes, what type of format?

☐ No

- Are there any other types of submissions for certification, such as a paper?

☐ Yes

If yes, what else is required? \_\_\_\_\_

☐ No

- Approximately how long does it take to take the exam(s)? \_\_\_\_\_

#### *Exam Training*

- Does your company provide training materials for the certification exam(s)?

☐ Yes

If yes, are they online/computer-based training (CBT)?

☐ Yes

☐ No

☐ No

- Do third parties provide training materials for the certification exam(s)?

☐ Yes

☐ No

- Approximate time to prepare for exam(s)? \_\_\_\_\_

- What is the estimated cost for training and/or materials for exam(s)?

\_\_\_\_\_

*Employment Impact*

- Are there any known jobs where the certification is a requirement for employment?
- Are there any surveys of the certification that have salary information?

**List of Certification and Accreditation Organizations within Scope of Study**

Category	Name	Short Name	Address	Address 2	City	ST	ZIP	Web	Phone
Accreditation	American Council on Education	ACE	One Dupont Circle NW		Washington	DC	20036-1193	<a href="http://www.acenet.edu/">http://www.acenet.edu/</a>	202-939-9300
Accreditation	American National Standards Institute	ANSI	1899 L Street, NW	11th Floor	Washington	DC	20036	<a href="http://www.ansi.org/">http://www.ansi.org/</a>	202-293-8020
Accreditation	Council of Engineering & Scientific Specialty Boards	CESB	PO Box 1448		Annapolis	MD	21401	<a href="http://cesb.org/">http://cesb.org/</a>	410-266-3766
Accreditation	International Certification Accreditation Council	ICAC	16212 Pinerock Drive		Tampa	FL	33624	<a href="http://www.icacnet.org/">http://www.icacnet.org/</a>	813-777-0566
Accreditation	International Cost Engineering Council	ICEC	PO Box 301	Australia	Deakin West	ACT	2601	<a href="http://www.icoste.org/">http://www.icoste.org/</a>	
Accreditation	National Commission for Certifying Agencies (NCCA)/Institute for Credentialing Excellence	NCCA/ICE	2025 M Street, N.W.	Suite 800	Washington	DC	20036	<a href="http://www.credentialingexcellence.org/">http://www.credentialingexcellence.org/</a>	202-367-1165
Accreditation	National Institute for Metalworking Skills	NIMS	10565 Fairfax Boulevard	Suite 203	Fairfax	VA	22030	<a href="https://www.nims-skills.org">https://www.nims-skills.org</a>	703-352-4971
Accreditation	National College Credit Recommendation Services	NCCRS	89 Washington Avenue	Education Bldg., Room 1069	Albany	NY	12234	<a href="http://www.nationalponsi.org/">http://www.nationalponsi.org/</a>	518-486-2070
Vendor-Neutral	American Design Drafting Association	ADDA	105 East Main Street		Newbern	TN	38059	<a href="http://www.adda.org/">http://www.adda.org/</a>	731-627-0802
Vendor-Neutral	American Society for Engineering Management	ASEM	223 Engr. Mgmt. Bldg.	600 W. 14th St.	Rolla	MO	65409	<a href="https://netforum.avectra.com/eWeb/StartPage.aspx">https://netforum.avectra.com/eWeb/StartPage.aspx</a>	573-341-6228
Vendor-Neutral	American Society for Quality	ASQ	600 North Plankinton Ave.		Milwaukee	WI	53203	<a href="http://asq.org/">http://asq.org/</a>	800-248-1946
Vendor-Neutral	American Society of Mechanical Engineers	ASME	Three Park Avenue		New York	NY	10016-5990	<a href="http://www.asme.org/">http://www.asme.org/</a>	800-843-2763
Vendor-Neutral	APM Group - US	APMG	213 Burlington Road	Unit 101	Bedford	MA	01730	<a href="http://www.apmgroupltd.com/">http://www.apmgroupltd.com/</a>	781-275-8604
Vendor-Neutral	Association of Energy Engineers	AEE	4025 Pleasantdale Rd	Suite 420	Atlanta	GA	30340	<a href="http://www.aeecenter.org/">http://www.aeecenter.org/</a>	770-447-5083
Vendor-Neutral	Association for Facilities Engineering	AFE	12801 Worldgate Drive	Suite 500	Herndon	VA	20170	<a href="http://www.afe.org/">http://www.afe.org/</a>	571-203-7171
Vendor-Neutral	Association for Manufacturing Excellence	AME	3701 Algonquin Rd.	Suite 225	Rolling Meadows	IL	60008-3127	<a href="http://www.ame.org/">http://www.ame.org/</a>	224- 232-5980
Vendor-Neutral	Association for Operations Management	APICS	8430 West Bryn Mawr Ave.	Suite 1000	Chicago	IL	60631	<a href="http://www.apics.org/">http://www.apics.org/</a>	773-867-1777
Vendor-Neutral	Association for the Advancement of Cost Engineering	AACE	209 Prairie Ave	Suite 100	Morgantown	WV	26501-5934	<a href="http://www.aacei.org/">http://www.aacei.org/</a>	304-296-8444
Vendor-Neutral	Association of Technology, Management and Applied Engineering	ATMAE	1390 Eisenhower Place		Ann Arbor	MI	48108	<a href="http://www.atmae.org">http://www.atmae.org</a>	734-677-0720
Vendor-Neutral	Board of Certified Safety Professionals	BCSP	2301 W. Bradley Avenue		Champaign	IL	61821	<a href="http://www.bcsp.org/">http://www.bcsp.org/</a>	217-359-9263
Vendor-Neutral	Computing Technology Industry Association	CompTIA	3500 Lacey Road	Suite 100	Downers Grove	IL	60515	<a href="http://www.comptia.org/">http://www.comptia.org/</a>	630-678-8300
Vendor-Neutral	Council on Quality and Leadership	CQL	100 West Road	Suite 300	Towson	MD	21204	<a href="http://www.thecouncil.org/">http://www.thecouncil.org/</a>	410-583-0060
Vendor-Neutral	Electronics Technicians Association International	ETA-I	5 Depot St.		Greencastle	IN	46135	<a href="http://www.eta-i.org/">http://www.eta-i.org/</a>	800-288-3824
Vendor-Neutral	Institute of Electrical and Electronics Engineers	IEEE	3 Park Avenue	17th Floor	New York	NY	10016-5997	<a href="http://www.ieee.org/">http://www.ieee.org/</a>	212-419-7900
Vendor-Neutral	Institute of Industrial Engineers	IIE	3577 Parkway Lane	Suite 200	Norcross	GA	30092	<a href="http://www.iienet2.org/">http://www.iienet2.org/</a>	770-449-0460
Vendor-Neutral	Institute for Supply Management	ISM	P.O. Box 22160		Tempe	AZ	85285-2160	<a href="http://www.ism.ws/">http://www.ism.ws/</a>	480-752-6276
Vendor-Neutral	International Association for Radio, Telecommunications and Electromagnetics, Inc.	INARTE	840 Queen St.		New Bern	NC	28560	<a href="http://www.narte.org/">http://www.narte.org/</a>	800-89-NARTE
Vendor-Neutral	International Information Systems Security Certification Consortium, Inc.	(ISC)2	1964 Gallows Road	Suite 210	Vienna	VA	22182	<a href="https://www.isc2.org/">https://www.isc2.org/</a>	703-891-6781
Vendor-Neutral	International Society of Automation	ISA	67 Alexander Drive	PO Box 12277	Research Triangle Park	NC	27709	<a href="http://www.isa.org/">http://www.isa.org/</a>	919-549-8411
Vendor-Neutral	International Society of Certified Electronics Technicians	ISCET	3608 Pershing Ave.		Fort Worth	TX	76107-4527	<a href="http://www.iscet.org/">http://www.iscet.org/</a>	817-921-9101
Vendor-Neutral	Linux Professional Institute	LPI	1024 Iron Point Rd.		Folsom	CA	95630	<a href="http://www.lpi.org/">http://www.lpi.org/</a>	916-357-6625
Vendor-Neutral	Manufacturing Skill Standards Council	MSSC	140 King Street		Alexandria	VA	22314	<a href="http://www.msscusa.org/">http://www.msscusa.org/</a>	703-739-9000
Vendor-Neutral	Material Handling & Management Society	MHMS	8720 Red Oak Blvd	Suite 201	Charlotte	NC	28217-3992	<a href="http://www.mhia.org/">http://www.mhia.org/</a>	704-676-1190
Vendor-Neutral	National Board for Professional Teaching Standards	NBPTS	1525 Wilson Blvd.	Suite 500	Arlington	VA	22209	<a href="http://www.nbpts.org/">http://www.nbpts.org/</a>	800-22TEACH
Vendor-Neutral	National Institute for Certification in Engineering Technologies	NICET	1420 King Street		Alexandria	VA	22314-2794	<a href="http://www.nicet.org/">http://www.nicet.org/</a>	888-IS-NICET
Vendor-Neutral	Project Management Institute	PMI	14 Campus Boulevard		Newtown Square	PA	19073-3299	<a href="http://www.pmi.org/">http://www.pmi.org/</a>	610-356-4600
Vendor-Neutral	The Society for Standards Professionals	SES	1950 Lafayette Road	Box 1	Portsmouth	NH	3801	<a href="http://www.ses-standards.org/">http://www.ses-standards.org/</a>	603-926-0750
Vendor-Neutral	Society of Manufacturing Engineers	SME	One SME Drive		Dearborn	MI	48128	<a href="http://www.sme.org/">http://www.sme.org/</a>	313-425-3000
Vendor-Neutral	Society of American Value Engineers	SAVE	136 South Keowee Street		Dayton	OH	45402	<a href="http://www.value-eng.org/">http://www.value-eng.org/</a>	937-224-7283
Vendor-Specific	Autodesk, Inc.	Autodesk	111 McInnis Parkway		San Rafael	CA	94903	<a href="http://usa.autodesk.com/">http://usa.autodesk.com/</a>	800-538-6401
Vendor-Specific	Cisco Systems, Inc.	Cisco	170 West Tasman Dr		San Jose	CA	95134	<a href="http://www.cisco.com/">http://www.cisco.com/</a>	
Vendor-Specific	CNC Software, Inc.	CNC	5717 Wollochet Dr. NW		Gig Harbor	WA	98335	<a href="http://www.mastercam.com/">http://www.mastercam.com/</a>	800-275-6226
Vendor-Specific	Microsoft Corporation	MS	One Microsoft Way		Redmond	WA	98052	<a href="http://www.microsoft.com">http://www.microsoft.com</a>	
Vendor-Specific	Novell	Novell	404 Wyman Street	Suite 500	Waltham	MA	02451	<a href="http://www.novell.com">www.novell.com</a>	800-529-3400



**Appendix Eight****Informed Consent****INFORMED CONSENT*****The Impact of Professional Certifications  
on Buffalo State College Technology Programs***

Participation in this research study is completely voluntary. Please read the information below and ask questions about anything that you do not understand before deciding if you want to participate. A researcher listed below will be available to answer your questions.

**RESEARCH TEAM AND SPONSORS**

**Name and title of Lead Researcher:** Christopher Nicholas Brown  
Industrial Technology, Upton Hall, 314  
Telephone: (716) 884-1914  
Email: cbrown4884@aol.com

**Study Location(s):** TBD

**PURPOSE OF STUDY**

The purpose of this research study is to assess, measure, and analyze the role of voluntary, nationally-recognized professional certifications to augment related applied technology programs at higher-education institutions offering applied technology curricula. The scope of the study includes: a.) analysis of applied technology program enrollment trends; b.) the value/awareness of associated professional certifications including assessment, requirements analysis, and volume trends; as well as c.) curriculum integration of professional certifications' in postsecondary technology programs within the scope of the study.

**SUBJECTS*****Inclusion Requirements***

You are eligible to participate in this study if you meet one or more of the following criteria:

- 1) You are a BSC alumni from one or more of the six programs included in this study:
  - a. Computer Information Systems, B.S.
  - b. Electrical Engineering Technology: Electronics, B.S.
  - c. Electrical Engineering Technology: Smart Grid, B.S.

- d. Industrial Technology, B.S.
  - e. Mechanical Engineering Technology, B.S.
  - f. Technology Education, B.S.
- 2) You are a BSC or other relevant technology faculty member;
  - 3) You are a technology hiring managers or technology industry leader
  - 4) You are a non-BSC alumni professional certification holders or are an alumni of a regional technical college

***Exclusion Requirements***

You are not eligible to participate in this study if you do not meet the inclusion requirements described above.

***Number of Participants***

This study will include approximately 60 subjects and will involve approximately 1-2 hours of your time.

**PROCEDURES**

The following procedures will occur:

- 1.) A list of questions will be provided to the subject in advance of the interview.
- 2.) A method of interviewing will be agreed upon prior to commencement (face-to-face or telephone).
- 3.) The researcher will ask the subject the questions who will answer them to the best of their ability.

Interviews will be recorded using a MP3 recorder, if the subject permits recording. If not, responses to the survey will be recorded using pen and paper.

***Total Time Commitment***

You will be involved in this study for 1-2 hours.

**RISKS AND DISCOMFORTS**

There are no known risks or discomforts associated with this study.

**BENEFITS*****Benefits to the Participant***

The possible benefits you may experience from the procedures described in this study include the ability to share your opinions and knowledge about the topic of the research study.

***Benefits to Others or Society***

It is anticipated that the results of this research will help students and workers make informed decisions about professional certifications and will help researchers in the three key technology areas of the study: enrollment, value/integration, and awareness of technical professional certifications.

**ALTERNATIVES TO PARTICIPATION**

The alternative to the procedures in this study is not participate in this study.

**COMPENSATION, COSTS AND REIMBURSEMENT*****Compensation for Participation***

You will not be paid for your participation in this research study.

**WITHDRAWAL OR TERMINATION FROM THE STUDY AND CONSEQUENCES**

You are free to withdraw from this study at any time. **If you decide to withdraw from this study you should notify the research team immediately.**

**CONFIDENTIALITY*****Data Storage***

Your research records will be stored in the following manner:

- Identifiable information about you will be kept with the study data.
- All paper-based study data will be kept under lock and key and only authorized research team members will have access to it.
- All data stored electronically will be stored on a secure network server, or on portable devices, such as a laptop with encryption (special software) and password protection.
- Audio, video recordings and paper notes will be maintained for a minimum of three years. Other researchers may access to the data for future research.

The researchers plan to maintain your identifiable research data for approximately 3 years.

**NEW FINDINGS**

If, during the course of this study, significant new information becomes available that may relate to your willingness to continue to participate, this information will be provided to you by the researcher team listed at the top of the form.

**IF YOU HAVE QUESTIONS**

If you have any comments, concerns, or questions regarding the conduct of this research, please contact the research team listed at the top of this form.

If you are unable to reach a member of the research team listed at the top of the form and have general questions, or you have concerns or complaints about the research study, research team, or questions about your rights as a research subject, please contact The Research Foundation of SUNY/Office of Sponsored Programs by phone, (716) 878-6700 or by e-mail at [gameg@rf.buffalostate.edu](mailto:gameg@rf.buffalostate.edu) or in person at Bishop Hall, Room 17, 1300 Elmwood Avenue, Buffalo, NY 14222.

**VOLUNTARY PARTICIPATION STATEMENT**

**Participation in this study is voluntary.** You may refuse to answer any question or discontinue your involvement at any time without penalty or loss of benefits to which you might otherwise be entitled. Your decision will not affect your future relationship with Buffalo State. Your signature below indicates that you have read the information in this consent form and have had a chance to ask any questions that you have about the study.

**SIGNATURE LINES**

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***Participant's Signature***

---

***Date***

---

***Researcher's Signature***

---

***Date***

## Appendix Nine

### **Transcription of *An Original Design for a Steam Engine*, a thesis by Daniel Upton and Benj. M. Harris**

Daniel Sherman Upton, with classmate Benjamin Marvin Harris (1866 - 1896) jointly authored the senior thesis, *An Original Design for a Steam Engine*. The thesis fulfilled Upton and Harris' graduation requirements for Cornell University's Mechanical Engineering program (class of 1890), and was submitted to the Cornell University library on June 21, 1890. While the technological subject matter is dated, the thesis is important because the subject, as chosen by Upton and Harris, disclosed their academic interests and foreshadowed the creation of the Mechanical Engineering program at Buffalo State College. Upton's work serves as both an inspiration and a model of academic rigor for Buffalo State College's technology students. The thesis is particularly relevant to Buffalo State because it was through Upton's efforts its Vocational Industrial Department was initiated and received significant subsequent development. The thesis is also significant because it contains, to the best of the researcher's knowledge, the only publicly-available extant engineering drawings by Upton, who was renowned for his technical drawing and pedagogical talents. Daniel Upton, the "Father of Vocational Training in Buffalo," contributed so much to Buffalo's industrial educational programs, as discussed in Chapter Two of this study.

Benjamin Harris was born on November 15, 1866 in Kendall, New York (approximately 70 miles northeast of Buffalo, bordering Lake Ontario), and was the son of Honorable Marvin Harris. In the mid-1880s Harris entered Cornell University's 1890 class of Mechanical Engineering. In addition to having a strong academic foundation, he was an athlete at Cornell: a wrestler, an oarsman, and a member of its 1889 football team. He was also a charter member of the Beta Theta chapter of the Alpha Tau Omega fraternity. He purchased a house on East Hill, near the Cornell University campus, which he then leased to Beta Theta for several years. After he graduated from Cornell, Harris moved to Chicago, Illinois and was employed by the Heidenreich Company. Harris then moved to Cleveland, Ohio where he worked for Hill Clutch Works. In 1893-1894 Harris returned to Cornell where he pursued post-graduate studies in electrical engineering. After he completed his post-graduate studies, Harris moved to New York City to begin a career in electrical engineering. In 1895, he secured a mechanical engineering position with the Guggenheim Smelting Works (Died in Mexico, 1896). In December, Harris developed typhoid and malaria fever while working for Guggenheim in Aguascalientes Mexico. Harris died in Mexico on May 2, 1896 when he was 29 years old (Benjamin Marvin Harris, 1896, p. 237). Because of Mexican contagion containment laws, Harris' remains were held there for three years. Harris' remains were finally returned to his family and interred in their plot at Kendall (Buried Finally at Home, 1899).

Harris' sister, Caroline "Carrie" Estella Harris, wife of physician Dr. John Duncan Bonnar, was a longtime resident of Buffalo and moved there at the time of her marriage in 1885. The Bonnars had four children; one of their sons, Benjamin Horace Bonnar, was named for Benjamin Marvin Harris (Smith, Men You Ought to Know. Dr. John D. Bonnar., 1932, p. 7.5). A photograph of Benjamin Harris is shown in Figure 39.

Upton and Harris had much in common at Cornell. Besides producing their thesis and being graduates of the 1890 Cornell Mechanical Engineering program, both Upton and Harris were members of the Beta Theta chapter of Alpha Tau Omega and were members of the 1889 Cornell football team.

Many of the theses from Cornell in 1890 were typewritten. However, the typewriter's limited capabilities could not contain the thesis' complex mathematical equations; therefore Upton and Harris' thesis was handwritten. This appendix represents the researcher's efforts to convert Upton and Harris' thesis to a content-searchable digital format and make it accessible to a twenty-first century audience for the first time since 1890. Throughout their thesis, Upton and Harris made extensive references to William Rankine's *A Manual of the Steam Engine and other Prime Movers* (Rankine, 1859). Other works referenced included Daniel Clark's *Railway Machinery* (Clark, 1875); Weisbach's *Mechanics* (Weisbach, 1875, pp. 529, 537); and William Mark's *Steam Engine* (Marks, 1884).

The researcher would like to believe Dr. Upton and Mr. Harris would be pleased contemporary imaging technology will enable their work to be accessible to a broad audience. The researcher digitized a microfilmed copy of the thesis into a tagged image file format and transcribed it with Microsoft's Word 2010 word-processing program, utilizing its Equation Editor feature for mathematical formulas. The researcher then worked with Ana Guimaraes, Head of Reference Services, Reproductions & Permissions Division of Rare and Manuscript Collections, Cornell University Carl A. Kroch Library, to digitally photograph originals of Upton and Harris' drawings included here.



**Figure 39. Benjamin Harris 1866-1896.**  
*Alpha Tau Omega Palm.*

An  
Original Design  
for a  
Steam Engine

Thesis by  
Daniel Upton  
Benj M. Harris

Cornell – Class of '90

### Introduction

In this design the writers have striven to be original as nearly as possible. The Corliss type of cutoff has been adopted, but it is simply in type and not in the mechanism of the valve gearing. Of course the short quick action of the Corliss cutoff once having been thought out by Mr. Corliss this much must be accorded to him forever, but in the present case it has been the aim of the authors to refine the mechanism operating the valves giving the desired results of quick cut off action with equal precision, but with greater simplicity of moving parts. Other minor details have been introduced which will be fully explained in the course of this treatise. In presenting this thesis the writers claim to have invented no new mechanical ideas but frame the ideas of the thinkers and inventors of the past, have gathered what we consider the best suggestions and clustered them as best suit our ideas of the needs of the time.

Upton and Harris

### Thesis

As is given by the subject we propose to design a steam engine. To be more explicit, our design is to be an automatic cut off engine of Corliss type and of 250 H.P. The engine is designed throughout in the following thesis; taking it up thermodynamically and estimating from that standpoint its efficiency. The valve gearing and governor are so far as we know original with the authors and so far as possible the whole idea of the engine is our own. To give a ready idea of the method of treatment we would summarize as follows

- (a). Thermodynamic problems
- (b). Proper design of parts for strength
- (c). Design of valve gearing and governor
- (d). Heater.

### Thermodynamic Problem

In the working of the thermodynamic problem a single case was taken with 85 lbs. steam pressure per gauge. This problem was solved, for a jacketed and an unjacketed cylinder. From the results for an ideal case the efficiencies for the real case are obtained. Finally a comparison is made with the results obtained for the real case with and without a jacketed cylinder. The object of this comparison being to determine which is the more efficient from a financial point of view. Rankine's method is followed in the solution of this problem.

### Problem

Data

$$p_1 = 100^{\#} \text{ absolute}$$



$r = 4 =$  ratio of expansion

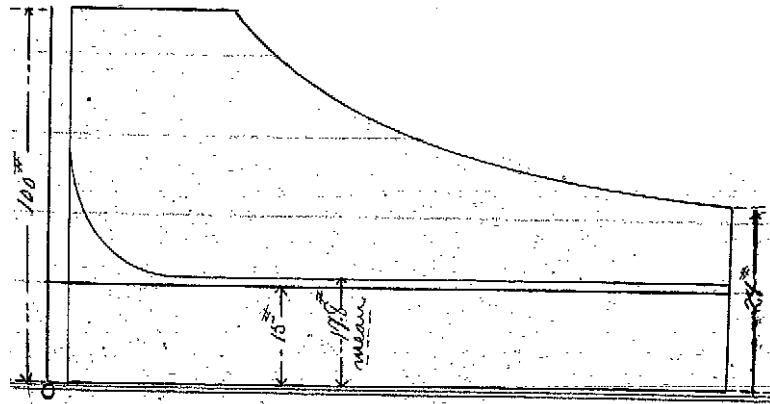
$p_3 = 17.8$  absolute

$T = 200^\circ =$  Temperature of feed water

Exhaust passes through in heater giving the above value  $T$ .

### Part first

Non-conducting cylinder i.e. one which produces adiabatic expansion in the working fluid



The preceding card is an approximation to the card drawn theoretically for the cylinder in question.

Absolute pressure at admission

$p_1 = 100^\#$  per sq. in.

14400<sup>#</sup> per sq. ft.

Absolute terminal pressure

$p_2 = \frac{p}{r \frac{10}{9}} = 24^\#$  sq. in

3456<sup>#</sup> per sq. ft.

Absolute back pressure

$p_3 = 17.8^\#$  sq. in.

2536 per sq. ft.

Temperature of feed water

$T_4 = 200^\circ$

$\tau_4 = 661.^\circ 2 =$  (absolute)

Temperature of atmosphere

$T_6 = 65^\circ$

$\tau_6 = 526.^\circ 1 =$  (absolute)

From Table IV Rankine the following is obtained corresponding to  $p$ .

Ordinary temperature  $T_1 = 327. ^\circ 59$

Absolute "  $\tau_1 = 788. ^\circ 79$

Latent heat of evaporation  $L_1 = 157162$  fl. lbs.

Density  $= \frac{1}{v} = D_1$   $D_1 = .2303^\#$

Corresponding to  $p_2$

$T_2 = 237. ^\circ 7$

$\tau_2 = 698. ^\circ 9$

$L_2 = 44059$  ft. lbs.

$D_1 = .06022$

$r = 4.$

From Rankine p. 388 Equation 4.

Energy per cu. ft. of steam admitted

$$UD_1 = JD_1 \left\{ \tau_1 - \tau_2 \left( 1 + \text{hyp. log} \frac{\tau_1}{\tau_2} \right) \right\} + \frac{\tau_1 - \tau_2}{\tau_1} L_1 + r(p_2 - p_3)$$

$$= 772 \times .2303 \{ 788.79 - 698.9(1 + \text{hyp. log} 1.127) \} + \frac{90.79}{788.79} \times 157162$$

$$+ 4(3456 - 2536)$$

$$= 22415 \text{ foot lbs.}$$

Mean effective pressure.

$$p_8 = \frac{UD_1}{r}$$

$$= \frac{22415}{4} = 5603.7^\# \text{ per sq. ft.}$$

$$= 38.92^\# \text{ per sq. in.}$$

Heat expended per cu. foot swept through by piston i.e. energy exerted.

$$\frac{H_1 D_1}{r} = \frac{17946.45}{4} = 4498.4^{\#} \text{ sq. ft.}$$

$$= 312.4^{\#} \text{ sq. in.}$$

Heat expended per cu. ft. of steam admitted

$$H_1 D_1 = J D_1 (\tau_1 - \tau_4) + L_1$$

$$= 772 \times .2303(788.79 - 661.2) + 157.162$$

$$= 179846.45 \text{ ft. lbs.}$$

Efficiency of steam.

$$\frac{U_1 D_1}{H_1 D_1} = \frac{22415}{179846}$$

$$= .1248.$$

Net feed water per. cu. ft. swept through by piston.

$$\frac{D_1}{r} = \frac{.2303}{4}$$

$$= .0575^{\#}$$

Heat rejected per. cu. ft. of steam admitted

$$H_1 D_1 - U D_1 = 179846 - 22415.$$

$$= 157431 \text{ foot lbs.}$$

Heat rejected per. cu. foot swept through by piston.

$$\frac{(H - U) D_1}{r} = \frac{157431}{4}$$

$$= 39357.86 \text{ foot lbs.}$$

Cubic feet to be swept through per H.P. per min.

$$\frac{33000}{p_m - p_3} = \frac{33000}{U D_1} r = \frac{33000}{5603.7}$$

$$= 5.9 \text{ cu. ft.}$$

Available heat expended per. I.H.P. per hour.

$$\frac{1980000}{\text{efficiency}} = \frac{1980000}{.1248}$$

$$= 16256412 \text{ ft. lbs.}$$

Now assuming the available heat of combustion to be .8% the total heat of combustion or in other words assuming the efficiency of furnace to be .8 and the total heat of combustion of a certain grade of coal to be 12 000 000 ft. lbs. to the lb. we would have the available heat

$$.8 \times 12\,000\,000$$

$$= 9\,600\,000 \text{ ft. lbs.}$$

We have found that it takes .16256412 ft. lbs. per I.H.P. per hour for our cylinder therefore it takes  $\frac{.16256412}{9600000}$  lbs. of coal per I.H.P. per hour.

$$= 1.68 \text{ lbs. coal per hour}$$

Cubic feet swept through by piston per I.H.P. per min. = 5.9 therefore for I.H.P. per hour it would be = 354 cu. ft.

We have the amount of feed water per cubic foot swept through by piston therefore we can find the total amount of feed water per I.H.P. per hour as follows

$$354 \times .0575$$

$$= 20.35^{\#}$$

### Corrections for Wastes in Real Engine

Correction for wastes assumed at

$$.2\sqrt{r} = .4 \quad \text{since } r = 4.$$

We have ideal efficiency = .1245 and our total waste is assumed at .4 of this efficiency = .0498. Now .1245 - .0498 = actual efficiency of fluid

$$= .0747$$

Applying this efficiency to the equation  $\frac{1\,980\,000}{\text{efficiency}}$  available heat expended per I.H.P. per hour

$$= 26\,500\,000$$

Applying further to the formula for number of lbs. of coal per I.H.P. per hour we would have  $\frac{26\,500\,000}{9\,600\,000}$

$$= 2.8^{\#} \text{ per hour.}$$

### Jacketed Engine

Here we assume exactly the same  $p$  and  $V$  and also  $r$  as in the previous case, but the working fluid having heat imparted to it from the steam in the jacket or better is unable to radiate heat on account of the temperature of the jacket, will not act along the same curve in expansion.

In treating this case, Rankine uses the volume  $V_1$  of one pound of steam at pressure  $p_1$  and from this by reference to the tables prepared,  $p_2$   $T_2$  are found.

### Data

$$p_1 = 100^{\#} \text{ sq. in.} \quad 14\,400^{\#} \text{ sq. ft.}$$

$$p_3 = 17.8^{\#} \text{ " " } \quad 2\,536^{\#} \text{ " " }$$

$$r = 4$$

From Rankine Table VI corresponding to  $p_1$

$$\text{Volume of } 1^{\#} \text{ steam} \quad V_1 = 4.336 \text{ cu. ft.}$$

$$\text{Ordinary temp. of steam} \quad T_1 = 327.59$$

$$\text{Absolute " " " } \quad \tau_1 = 788.79$$

Feed water

$$T_4 = 200$$

$$\tau_4 = 661.2$$

$$V_2 = V_1 r$$

From Table VI we have for  $1^{\#}$  steam occupying volume =

$$V_2 = 17.336 \text{ cu. ft.}$$

$$p_2 = 3325.9^{\#} \text{ sq. ft.} = 23.1^{\#} \text{ sq. in.}$$

$$T_2 = 235.53$$

$$\tau_2 = 696.73$$

From Rankine equation 3 p. 398 we have  $U^1$  energy exerted by 1<sup>#</sup> steam.

$$U^1 = a \cdot \text{hyp. log} \frac{\tau_1}{\tau_2} - b(\tau_1 - \tau_2) + v_2(p_2 - p_3)$$

$$a = 1109550$$

$$b = 540.4 \text{ ft. lbs. per } T \text{ degree.}$$

$$\begin{aligned} U^1 &= 1109550 \text{hyp. log } 1.13 - 540.4(92.06) + 17.344(789.9) \\ &= 104437 \text{ ft. lbs.} \end{aligned}$$

And from equation 5 we have  $\underline{h}$  or heat expended on 1<sup>#</sup> steam

$$\begin{aligned} &= J(\tau_2 - \tau_4) + a \left( 1 + \text{hyp. log} \frac{\tau_1}{\tau_2} \right) - b\tau_1 \\ &= 772(696.73 - 661.2) + 1109550 \left( 1 + \text{hyp. log} \frac{788.8}{696.73} \right) - 540.4(788.79) \\ &= 846304.16 \text{ ft. lbs.} \end{aligned}$$

Mean effective pressure

$$\begin{aligned} &= \frac{104437}{17.336} = 60.29^{\#} \text{sq. ft.} \\ &= 41.8^{\#} \text{sq. in.} \end{aligned}$$

Pressure equivalent of heat expended or  $\underline{h}$ .

$$\begin{aligned} ph &= \frac{h}{V_2} = \frac{846304}{17.34} = 48794^{\#} \text{sq. ft.} \\ &= 354^{\#} \text{sq. in.} \end{aligned}$$

Efficiency of steam is equal to mean effective pressure divided by pressure equivalent of heat expended

$$\begin{aligned} &= \frac{6029}{48794} \\ &= .124 \end{aligned}$$

Net feed water per cubic foot swept through by piston

$$\frac{D_1}{r} = \frac{.2304}{4}$$

$$= .0576^{\#}$$

Heat rejected per. lb. of steam admitted  $L - U^1$

$$L - U^1 = 846304 - 104437$$

$$= 741867 \text{ ft. lbs.}$$

Available heat expended per I.H.P. per hour.

$$\frac{1980000}{\text{efficiency}} = \frac{1980000}{.124}$$

$$= 16019418 \text{ ft. lbs.}$$

Consumption of coal using same efficiency of furnace and evaporative power as before.

$$12000000 \times .8 = 9600000$$

$$\text{and } \frac{16019418}{9600000} = \text{lbs. coal per I.H.P. per hour.}$$

$$= 1.66^{\#}$$

#### Corrections for Wastes.

In this case we have  $.15\sqrt{r}$

$$= .15\sqrt{4} = .3$$

Our efficiency of steam = .124 for the ideal case therefore true efficiency in the real case:

$$= .124 - (.124 \times .3)$$

$$= .087$$

Applying to equation for available heat expended per I.H.P. per hour

$$\frac{1980000}{.087}$$

= 22700000 ft. lbs.

Also applying for coal per I.H.P. per hour

$$\frac{22700000}{9600000}$$

= 2.36<sup>#</sup> per hour.

### Comparison.

A comparison of the more important of the more important results obtained from the forgoing problems i.e.

- I. Mean effective pressure.
- II. Efficiency of steam.
- III. Available heat expended per I.H.P. per hour.
- IV. Coal consumed per I.H.P. per hour.

### Ideal Case.

	Unjacketed	Jacketed
I.	38.92 <sup>#</sup>	41.8 <sup>#</sup>
II.	12.48%	12.4%
III.	16256412 ft. lbs.	16019418 ft. lbs.
IV.	1.68 <sup>#</sup>	1.66 <sup>#</sup>

### Real Case.

II.	.0747	.087
III.	26500000 ft. lbs.	22700000 ft. lbs.
IV.	2.8 <sup>#</sup>	2.36 <sup>#</sup>

It is seen that the thermodynamic efficiency of the real engine is greater with the jacket than without but this gain in efficiency seems to be too small to warrant the increase in expense of putting a jacket on the cylinder of this engine. The amount of coal burned is practically the same in both cases and as the engine is designed to be used in different parts of the country and for various purposes as in mills and shops it is thought by the authors best to make the design without the jacket. Again, the exact value of the thermodynamic wastes in engine cylinders is not yet known to the engineer, but only the approximate value so that the increased efficiency caused by jacketing a cylinder is but approximately known and as the gain here is so slight that a question arises as to whether it is of any marked value and hence it furnishes another good reason for not using the steam jacket.



Design of PartsCylinder

It is proposed to design a cylinder with minimum cost for a maximum efficiency and with sufficient strength to overcome all danger. In the theoretical working out of the efficiency of the engine reasons are given for using the unjacketed cylinder. The bolts for the cylinder head should be designed strong enough to resist the pressure on the cylinder head. The head itself should be stronger than the bolts and side walls of the cylinder should be still stronger. The reason for this is that the bolts are easily replaced if broken by overstrain, the head is not so easily replaced and hence is made a little stronger than the bolts and the cylinder proper is made the strongest of the three as it is difficult of casting and boring. The cylinder heads are to be highly polished to prevent radiation. The side walls are to be enclosed in a "Russia" iron casing fastened to the cylinder rim by top bolts. The space between the casing and the cylinder is to be packed with hair felt to prevent radiation and conduction. Plate 1(a) shows the cylinder in detail.

For Diameter and Length.Data

H.P. = 250

Gauge pressure = 85

Piston speed = 600 ft. per min (=max)

$L$  = Length of stroke in feet.

$A$  = area of piston in sq. in's =  $\frac{\pi D^2}{4}$

$R$  = no. of revolutions per min.

$$I.H.P. = 250 = \frac{p_e LAN}{33000}$$

$$p_e \pi D^2 = \frac{250 \times 33000}{150} = 55000$$

Absolute pressure = 85+15 = 100.

Cut off at  $\frac{1}{4}$  stroke.

In this type of engine the clearance is less than in ordinary type of engine.

To find clearance.

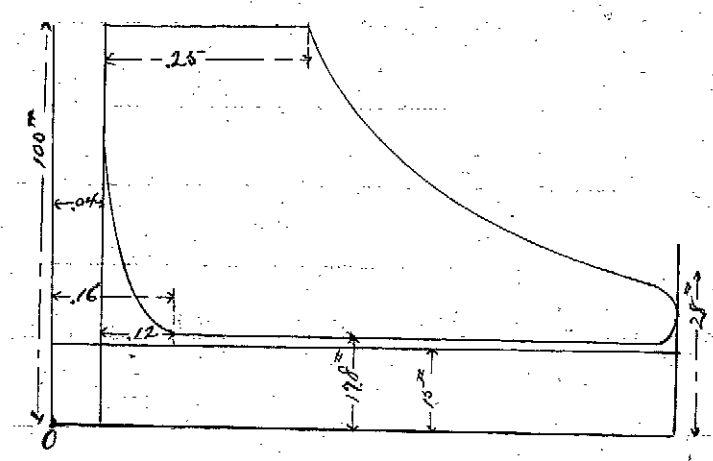
$$\pi R^2 \frac{1}{4} = 3.14 \times 100 \frac{1}{4} = 314 \div 4$$

$$\text{Part} = 27 \times 2 = 54$$

$$2 \times 54 = 108 \quad 108 + 314 = 432$$

$$432 \div 314 = 1.4$$

$$14 \div 340 = .04 = \text{Clearance}$$



$$\frac{x}{.04} = 4 \quad x = .16$$

$$N = \frac{104}{.29} = 3.6$$

$$36: (\log 3.6) + 1 :: 100: pm$$

$$pm = \frac{22809 \times 100}{3.6} = 63.36$$

Correction for clearance.

$$p_m = 63.36 \times 1.04 - 100 \times .04 = 61.89$$

$$N^1 = \frac{1.2 - 1.04}{.04} = 4$$

$$17 \times 4 = 68 = \text{terminal pressure:}$$

$$p_1 = \frac{68 \times \log_{\epsilon} 4}{4 - 1} = 31.4226$$

$$p_2 = 31.4226 \times .12 + 17 \times .88$$

$$p_2 = 18.734$$

$$p_{\epsilon} = p_m - p_2 = 61.89 - 18.73 = 43.16$$

$$p_{\epsilon} \pi D^2 = 55000$$

$$D = 21"$$

$$L = 2D = 42"$$

Cylinder Thickness

$$t = \frac{pD}{2500} + .5 = 1.16$$

$$\text{or } t = \sqrt[.03]{Dp}$$

$$= 1.23"$$

Head Thickness

$$t = 1.1 \text{ (thickness of cyl. + 25) (section )}$$

$$= 1.6"$$

Number & Size of Head Bolts.

Pitch Circle

$$21 \times 3 = 24$$

$$circ. = \pi D = 75.4$$

$$P = \sqrt{\frac{1.6 \times 100 \times 16}{85}} = \sqrt{\frac{25.6 \times 100}{85}} = 5.4$$

$$75.4 \div 5.4$$

$$= 14 \text{ no. of bolts}$$

$$\frac{\pi D^2}{4} \times 85 = a14 \times 3600$$

$$a = .54 \quad d = \frac{7}{8}$$

For thread cutting

$$d^1 = \frac{7}{8} + \frac{1.3}{8}$$

$$d^1 = 1" \text{ say}$$

### Piston Rings

$\beta$  = Width of rings

$$\beta = .63 \left( \frac{D\sqrt{p}}{50} + 1 \right)$$

$$\beta = .63 \left( \frac{21\sqrt{65}}{50} + 1 \right) = 2.88"$$

Each ring = 1.44"

### Piston Thickness

Cast Iron.

$$t = \sqrt{\frac{k \times d^2 \times p_5}{f}}$$

$$k = .207$$

$f = 3000$  for cast iron

$$p_5 = 85$$

$$d = 21"$$

$$t = \sqrt{\frac{.207 \times 21^2 \times 85}{3000}}$$

$$= 1.6"$$

Total thickness of piston =

$$= 1.6" + 2.88$$

$$= 4.5"$$

Total length of cylinder

$$= 42 + 4.5 + .5$$

$$= 47"$$

In all engine cylinders an amount of metal is left for roughness of castings and for each joint. In small engines

$$\text{For roughness of casting} = \frac{3}{16} "$$

$$\text{For each joint} = \frac{3}{32} "$$

$$3 \times \frac{3}{32} + \frac{3}{16} = \frac{15}{32} \text{ for each end}$$

$$\frac{15}{32} \times 2 = \frac{15}{16} \text{ in} = .94"$$

Then total length of cylinder in rough

$$= 47.94" \text{ or } 47 \frac{15}{16}$$

### Piston Rod

Steel rod.

$P_2$  = Load on piston rod

$$P_2 = \frac{FC}{1 + \frac{16}{9} \beta \frac{l^2}{k^2}}$$

$$F = \frac{I}{k^2} \quad I = \frac{\pi r^4}{4} \quad k^2 = \frac{d^2}{16} = \frac{r^2}{4}$$

$$F = \pi r^2 \quad \beta = \frac{1}{36000} \quad C = 36000$$

Factor of Safety = 6.

$l$  = Length of piston rod.

$$= 47.94" + 4.5" + 9" = 61.44$$

$$29410 = \frac{\pi r^2 6000}{1 + \frac{16}{9} \times \frac{1}{36000} \times \frac{61.44^2}{\frac{r^2}{4}}}$$

$$d = 3"$$

### Crank Shaft

#### Steel

$T$  = Safe stress per sq. in. in outer fibre.

$$U = \text{movement of flexure} = \frac{\pi d_{4f}^3}{64}$$

$d_{4f}$  = required diameter

$l$  = length of the part under consideration in ins.

$a$  = load in lbs.

$$G = \frac{\pi d_{4f}^3 F}{32 l} \text{ (Weisbachs Mechanics)}$$

$$d_{4f}^3 = \frac{32 GL}{\pi T}$$

$$d_{4f}^3 = 2.168 \sqrt[3]{\frac{GL}{T}}$$

$T$  = 9000 for steel

$$d_{4f}^3 = .00113 GL$$

$$d_{4f}^3 = .1042 \sqrt[3]{GL}$$

$$d_{4f}^3 = .1042 \sqrt[3]{25000 \times 12}$$

$$d_{4f}^3 = .1042 \times 67 = 6.9814$$

$D = 7"$  say. For flexure only.

Now for torsion only.

$$r = \text{length of crank in ins.} = \frac{h}{2}$$

$d_{4t}$  = required diameter of shaft in ins.

$T$  = safe stress in outer fibre.

$S = .7854 p_6 d^2$  = the stress at the extremity of crank.

$$Sr = .1963 d_{4t}^3 T \quad (\text{From W-----})$$

$$d_{4t}^3 = \frac{16Sr}{\pi T}, d_{4t}^3 = 2 \frac{P_6 d^2 L}{T}$$

$$d_{4t}^3 = 1.26 \frac{\sqrt[3]{p_6 d^2 L}}{T}$$

Now for steel shaft torsion

$$T = 6750$$

$$d_{4t} = .06667 \sqrt[3]{p_6 d^2 L}$$

$$d_{4t} = 6.8$$

$$d_{4t} = 7" \text{ say}$$

For torsion and flexure combined

$$d_4 = \frac{d_{4(t \text{ or } f)}}{\left[ 1 - \left( \frac{d_4}{d_{4f}^3} \right)^2 \right]^{\frac{1}{3}}}$$

$$d_4 = 7"$$

An increase of one inch in the diameter of crank shaft will make but little difference in the cost of the shaft, so it is thought best to make the shaft 8" in diameter.

### Crank Pin.

One of the most important parts in the design of an engine is the designing of the crank pin. It is the one part which seems to have given the engineer most trouble. The position of the pin and the force on it are such that it requires great strength and yet the friction is high so that it requires proper proportioning of parts and free lubrication to prevent heating. The writers have chosen the following for a good if not the best design.

Steel pin.

$d$  = diameter of piston head.

$p$  = mean pressure in cylinder.

$7854 d^2 p$  = mean pressure on piston head in ins.

$f$  = coefficient of friction.

$l_3$  = length of crank pin journals in ins.

$d_3$  = diameter of crank pin in ins.

The mean force of friction at rubbing surfaces of any crank pin journal per square inch of projected area.

$$= .7854 f \frac{P d^2}{l_3 d_3}$$

$N$  = number of strokes per minute =  $2R$

Space passed over by force due to friction, in one minute

$$= \frac{\pi U d_3}{2} = 1.5708 U d_3"$$

Work of friction.

$$W = 1.5708 \times .7854 f \frac{P N d^2}{l_3} \text{ in lbs.}$$



$W$  from table = 49908 inc. lbs.

$$49908 = 1.2337f \frac{PUd^2}{l}$$

$$l_3 = .000247fPNd^2 = 12.544 \frac{\pi}{L}$$

$$l_3 \times .0000247 \times .05 \times 2 \times 85 \times 21^2 \times 43.16$$

$$l_3 = 4.1313_f"$$

$$l_3 = 5" \text{ say}$$

### Diameter

$a$  = the deflection of pin under stress in inches

$S$  = Stress on pin in lbs.

$E$  = modulus of elasticity = 28 000 000

$W$  = Measure of moment of flexure of pin.

$l_3$  = length of journal in inches.

The deflection of a beam fixed at one end and loaded at the other.

$$a = \frac{Jl^3}{3WE} \quad S = \frac{\pi d^2}{4} P_8$$

$P_6$  = greatest pressure of steam in cylinder

= boiler pressure

$$\text{Let } W = \frac{\pi d_3^4}{64}$$

$$\frac{1}{100} = \frac{\frac{1}{3} \frac{\pi d^2}{4} p_6 l_3^3}{\frac{\pi d_3^4}{64} 28000 \ 000} = \frac{16 p_6 l_3^3 d^2}{84 \ 000 \ 000 d_3^4}$$

$$d_3 = .066 \sqrt[4]{p_6 l_3^3 d^2} = 1.758 \sqrt[4]{\frac{\pi l^3}{L N}}$$

$$d_3 = .066 \sqrt[4]{85 \times 5^3} \times 21^2$$

$$d_3 = 3.036$$

$$d_3 = 3.5" \text{ say}$$

### Univis Method

This method brings in heat by friction

$P$  = Total pressure

$$= \frac{33\,000 \times P \times 12}{4 R N} = 14000$$

$$l = \tau \frac{P}{R} = \tau \frac{250}{21} = 12 \times .6 = 7.2$$

$$l = 8"$$

$d$  for heating

$$\frac{l}{d} = .004N + 1$$

$$d = \frac{8}{.004 N + 1}$$

$$= 6"$$

$d$  for strength

$$= \sqrt[3]{\frac{5.1}{f}} \sqrt[3]{pl}$$

$$= \sqrt[3]{\frac{5.1}{9000}} \sqrt[3]{14000 \times 8}$$

$$= 4"$$

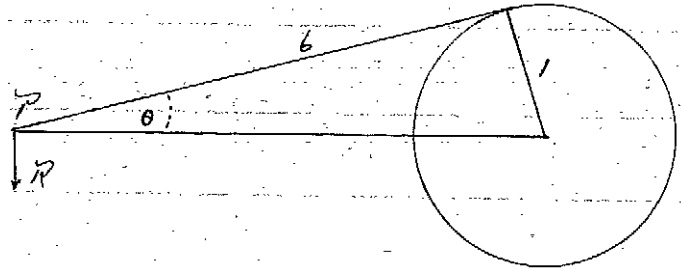
The conclusion is drawn from this that the best proportions for the crank pin are

$$l = 7"$$

$$d = 5''$$

### Connecting Rod

Steel.



Let  $l$  = length of connecting rod

= 3 stroke of the piston.

$$= 3 \times 42$$

$$= 126'' = 10' - 6''$$

$$\tan \theta = \frac{1}{\sqrt{36-1}}$$

$$P_o = \frac{FC \div 6}{1 + 4\beta \frac{l^2}{k^2}}$$

$$c = 36\,000$$

Factor of safety = 6

$$F = \pi r^2 = \frac{I}{K^2}$$

$$\beta = \frac{1}{36\,000}$$

$$K^2 = \frac{I}{F} = \frac{\pi r^4}{\frac{4}{\pi r^2}} = \frac{r^2}{4}$$

$$P = L \cos \theta$$

$$T = \frac{P}{\cos \theta} = P \sec \theta$$

$$\cos \theta = .985$$

$$\frac{29410}{.985} = \frac{\pi \tau^2 \times 6000}{1 + \frac{4}{36000} \times \frac{126^2}{\frac{\tau^2}{4}}}$$

$$d = 5.2"$$

This for rectangular section to be of good proportion.

$$= 6" \text{ by } 3.5"$$

### Crank Web

Steel

From Marks Steam Engine we get for the variable width of the web

$$v = \sqrt[8.095]{\frac{HP}{tN}}$$

$t$  = thickness of web

$N$  = Revolutions per minute

$$v = \sqrt[8.095]{\frac{250}{6 \times 85}}$$

$$= 7"$$

### Fly Wheel

In designing a fly wheel for an engine it is desired to get it of such a size and weight that there will be no perceptible change in the speed of the engine as it passes the dead points. In order to have such a condition of things. The wheel rim must contain stored energy enough at the dead points to carry the engine to half stroke without slack. A card was drawn and the stroke divided into a number of equal parts and through the atmospheric line a line was drawn bisecting it and making the ordinates above and below it as nearly equal as possible. The tangential components of the several pressures were

obtained by drawing a semicircle representing the engines half stroke. Now lines were drawn representing the connecting rod in its several positions corresponding to the several divisions of the card. Next a line was drawn, equal to one half the stroke ( $\frac{1}{2} l$ ). This line was divided into the same number of equal parts as the card. At each point of division ordinates were drawn equal to the corresponding tangential forces. A curve was then drawn with these ordinates and by means of the planimeter the area of this curve was determined and a rectangle of equal area was laid off on the base line equal  $1\frac{1}{2} l$ . The area of the curve above this rectangle was then measured and another rectangle drawn as before with a length equal to the distance between the points when the curve crosses the upper line of the first rectangle and with the area just determined.

Now

Let  $BB^1 =$  Length of the first rectangle

"  $DD^1 =$  " " " second "

"  $DG =$  Height " " " "

"  $AB =$  " " " first "

"  $W =$  Weight of the fly wheel minimum lbs.

"  $v =$  Mean velocity of the min if ft. per sec.

"  $v_1 \text{ \& } v_2 =$  Maximum and minimum velocity of mu

"  $\frac{1}{k} =$  Fraction of mean velocity allowed for variation

$$v_1 - v_2 = \frac{v}{k}$$

Work stored at maximum velocity

$$= v_1 = \frac{Wv^2}{G2}$$

Work stored at minimum velocity

$$= v_2 = \frac{Wv^2}{G2}$$

Work given out while velocity is reduced from  $v_1$  to  $v_2$

$$= \frac{W(v_1^2 - v_2^2)}{2G}$$

$$A \times DG \times DD = \frac{W(v_1^2 - v_2^2)}{2G}$$

$$= \frac{W(v_1 + v_2)(v_1 - v_2)}{2G} \quad v_1 + v_2 = 2v$$

$v_1 - v_2 = \frac{u}{k}$  whence we have

$$= \frac{W \times 2v \times \frac{v}{k}}{2G}$$

And

$$W = \frac{DG \times DD_1 \times A \times G \times k}{v_2}$$

$$v = \frac{\pi DN}{60}$$

Therefore

$$W = 11750 \frac{DG \times DD_1 \times A \times k}{D^2 N^2}$$

11750 being constant.

Let  $k$  in this case = 4.0

"  $D = 16'$  = diameter of fly wheel

To find  $U$  for the lowest speed of the engine is calculated at 65.

Hence

$$U = 65$$

$$D = 16'$$

$$DD^1 = 35 \text{ As determined from card}$$

$$DG = 24$$

$$A = 346$$

$$k = 40$$

$$W = 11750 \frac{24 \times 3.5 \times 34636 \times 40}{16^2 \times 65^2}$$

$$= 20400^\#$$

To find width of rim to transmit given horse power

$W$  = width of pulley or belt

$$W = \frac{H \times 1925}{D \times R} \quad (\text{J\&L hand book})$$

$D$  = diameter

$R$  = no. of revolutions

$$W = \frac{H \times 1925}{16 \times 12 \times 85} = \frac{481250}{16310}$$

$$= 30"$$

Cubic foot of cast iron

$$= 450^\#$$

$$20400 \div 450 = 45 \text{ cu. ft. in wheel rim.}$$

Length of rim = 50 ft.

$$\text{Width " " } = 25 "$$

$$50 \times 2.5 = 125$$

$$45 \div 125 = .36$$

$$= 4.32" = \text{thickness of rim}$$

Six spokes

### Eccentrics

The eccentrics are of the ordinary strap style and are shown in detail in Plate [A].

### Cross Head

Using Marks formula for slides.

$$S = \frac{396000 (HP)}{\sqrt{n^2 - 1} \times LN}$$

$L_1$  = max. pressure on guide in lbs.

$HP$  = Indicated horse power.

$N$  = ratio of length of connecting rod to crank

$L$  = length of stroke in inches.

$A$  = number of revolutions per minute

We have an overhand stroke therefore all pressure is born by lower guide “Marks Steam Engine” p. 46.

$$S = \frac{396000 \times 250}{\sqrt{4^2 - 1} \times 42 \times 85} = 7160^\#$$

Taking allowable pressure per sq. in. as 75 we have area of slide =  $\frac{7160}{75} = 96"$

= 16" × 6"

#### Port Areas

The steam ports according to D. K. Clark's “Railway Machinery” p. 108 are found as follows. He states that with a piston speed of 600 feet per minute a port area equal to one-tenth of the piston area is found sufficient to admit steam to the cylinder with sufficient facility for all practical purposes, and with but a slight reduction of pressure. The size of the port may be increased or diminished proportionately to the piston speed from these data with good success bearing in mind that all tortuousness of direction that can be should be avoided in steam ports. This is for slide valves and making all allowances the writers have decided that in this case  $\frac{1}{15}$  will be sufficient.

Piston area = 346 sq. in.

$346 \times \frac{1}{15} = 23$  sq. in. making ports  $1\frac{1}{2}" \times 15"$ .

#### Gearing for Admissions Valves

In this design the authors have been interested for some time and its final design has been entirely original with us. Others similar may exist but to our best belief such is not the case. For our scheme of mechanism we claim the following advantages –



automatic cutoff; ability to change speed of engine while in motion; change of feed both in steam feed and exhaust valves; and lastly and most important, simplicity.

The kinematic problem is as follows. Fig. I p. shows the general force of the admission and exhaust valves. The valve V rotates on the spindle S at the end of which is the crank arm C. From the other end of C runs the connecting rod r. This is made up of two parts joined by the sleeve D which is provided with right and left handed threads. See fig. I. a same page. Now, by this means, it will be seen, we have a means of adjusting the lead of the valve by simple taking up or extending the connecting rod by means of the sleeve. Fig. II p. shows the automatic stop whereby the throw of the valve is regulated. The arm C shown in the plan connects with the dash pot piston which will be exhibited and explained in a later figure. P is the rocker arm to which the eccentric rod is attached at Q. From K lead two arms a, a' in opposite directions and which as seen by the plan are slotted part of their length and carry in the slots the dogs m, m' which engage with the lugs n, n'. These lugs are fitted to the rods ε, ε' which have a sliding, but no rotary motion, in guides omitted here for the sake of simplicity. Now directly back of the lug n (r fig. I) connects with the sliding rod we are here describing. Now as will be readily seen if the rods ε and ε' are slid back or forward the motion is transmitted to the valves, and therefore by proper adjustment the main eccentric is made to open the valve. Now as to release and variable cut off (see fig. III p. ) it is accomplished as follows a, a are the same as shown in fig. II p. on the outside of a, a are bolted the arms g, g which slide over the eccentrics f, f. As will be seen if the eccentrics be turned up or down the arms a, a will be also raised or lowered and the dogs m, m engage with or disengage from the lugs n, n if the eccentrics are left in their normal condition. The dogs will not disengage till the arm has been thrown full over and this occurs at any part of the stroke or which the cut off may be set. But if the eccentrics be thrown up release occurs earlier in the stroke and this is affected by the governor which is attached by the rods J.J. fig. III to the eccentric. The action of these governor rods will be explained with the governor. When release occurs between the dogs and the lugs the quick return of the valve and therefore quick cut of is caused by the dash pot I. From the piston in this dash pot runs the curved arm C which is attached to the end of the rods ε, ε, which are the same as ε, ε, fig. III. The dash pots work by vacuum which is made as the piston is drawn forward by the same movement as the main valve. This quick cut off give the sharp corner on the indicator card.

The previous pages have given, we hope, an idea of the admission valves and since the mechanism of their movements is entirely independent of the exhaust valves movement, but independent upon the governor we will take that up next.

\*The gearing to right is omitted here for the sale of brevity – being similar to that on right.

#### Governor [Plate B]

The movement of the governor is simple and quickly understood by reference to fig. IV p. As the speed increases the arms a, a, swing out raising the ball crank arms b c and giving a pull and thrust to the rods J J (see fig. III) respectively operating the eccentrics K K fig. III p and cause gently adjusting the cut off. The weight W being slid

along its lever arm  $\underline{g}$  will give a greater weight for the governor arm to lift and here comes in our arrangement for changing the speed while the engine is running. The motion of the governor is derived through gearing connected directly to the main shaft thereby doing away with the danger of belts slipping or breaking this causing the engine "to run away."

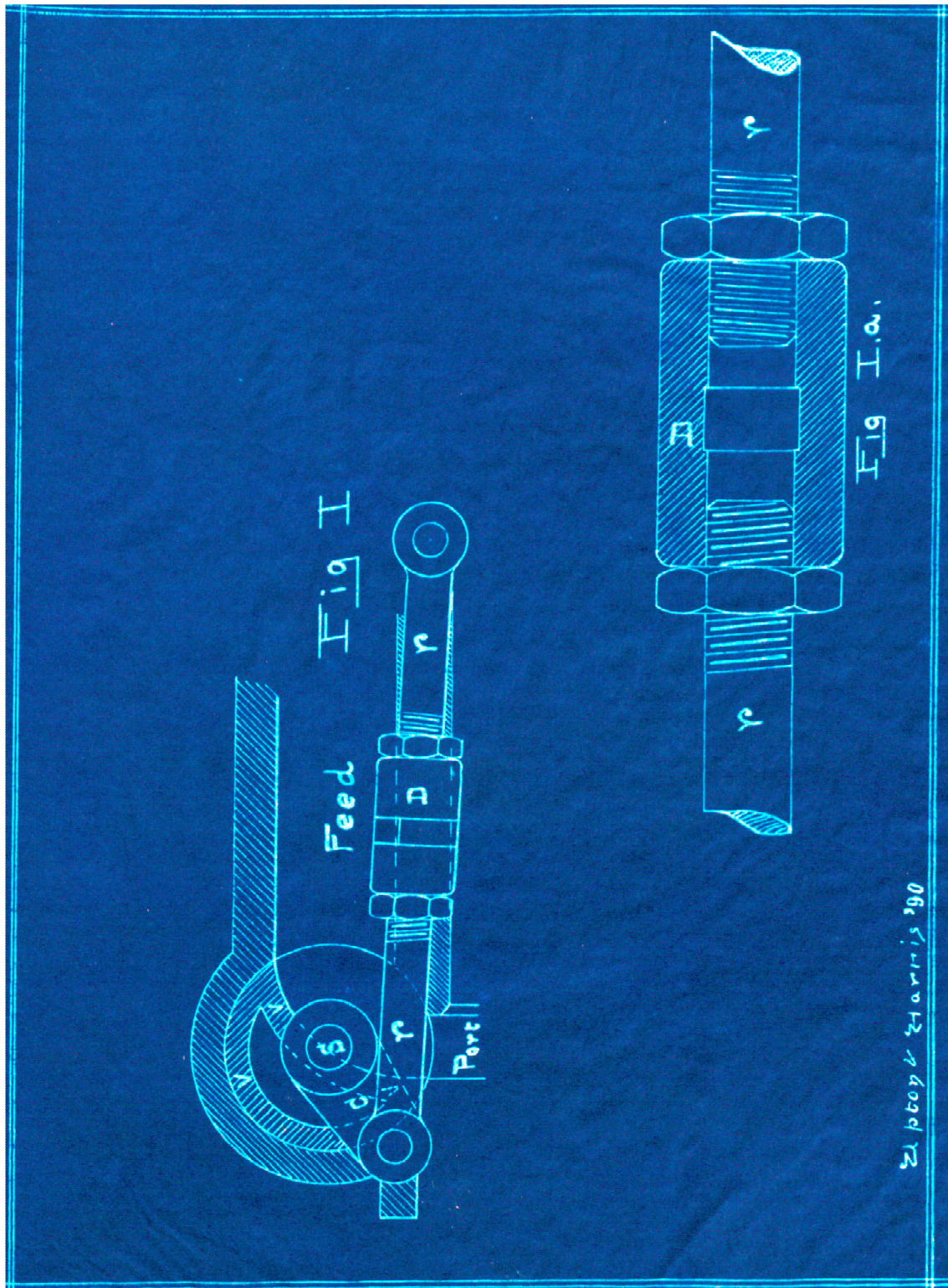
### Exhaust Gearing

As has been said the mechanism of the exhaust is entirely separate from that of the admission valves and worked on an entirely different plan; our object being to get a full release for the steam as quickly as possible thereby securing a gain at the end of the card as seen by the full line here in place of the dotted one the shaded area being work gained.

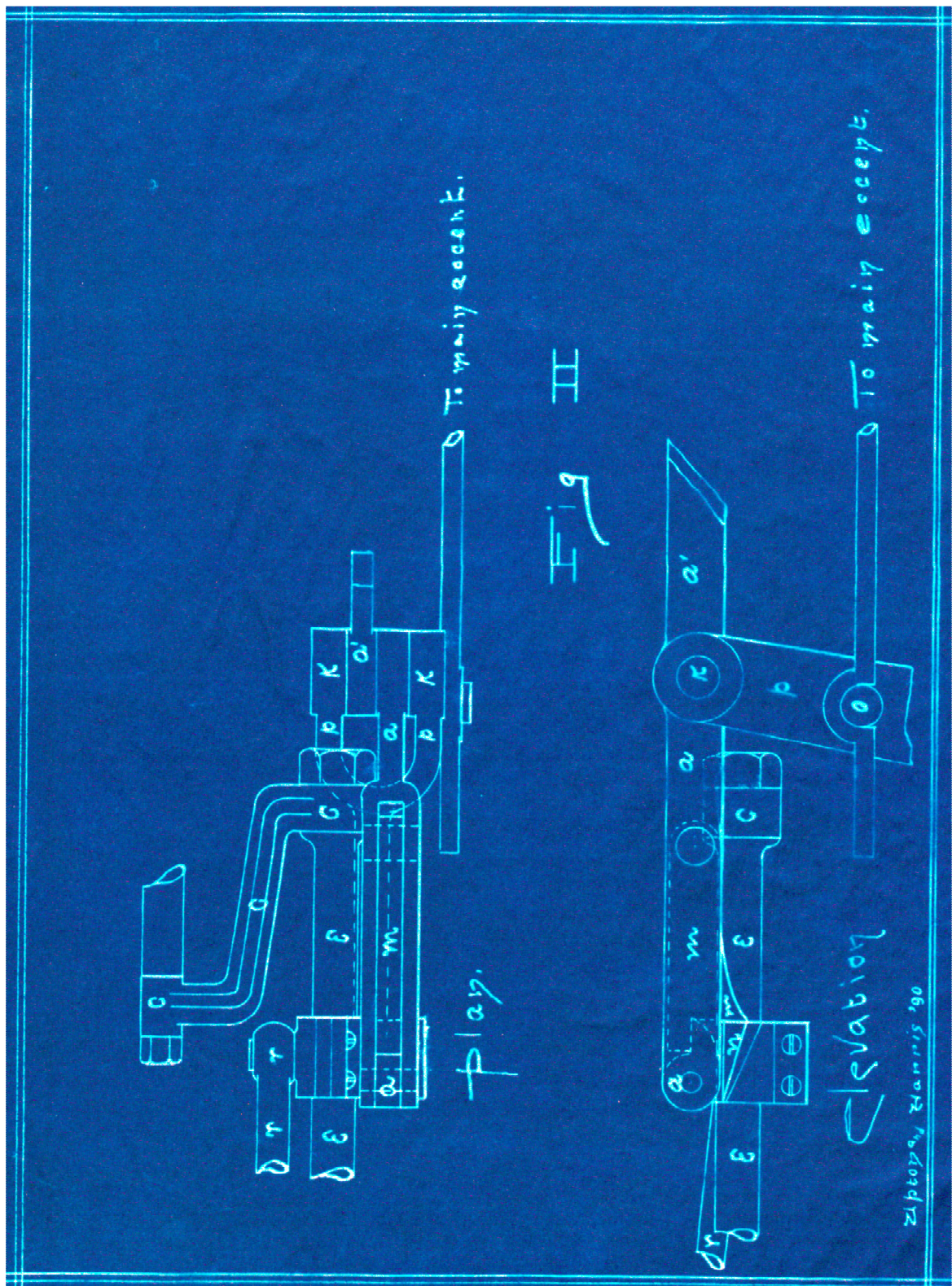


Our mechanism is shown in fig. V p. The valves are precisely the same as those shown already for admission spindle  $\underline{S}$  in that upon which it rotates. Only the mechanism for one valve at one end is shown both being precisely similar. That dotted in is the position when open  $\underline{S}$  is connected by a rocker arm to the piston of the dash pot which acts to open the valve thereby giving us quick release. Upon  $\underline{S}$  is also fastened the lug  $\underline{l}$  which engages with the cam  $\underline{K}$ . Now as the cam rotates the lug follows the curved outline  $\underline{Q}$  and gives a quick closing of the valve and when the cam has rotated so that  $\underline{f}$  passes  $\underline{L}$  the dash pot jerks the valve open. This point can be made at any point of the stroke by slipping the circular feather  $\underline{f}$  around the periphery of the cam and setting it tight with the screws  $\underline{h. h.}$  The point of exhaust closure and cushioning is regulated by slipping the cam around on the spindle on which it is mounted. The cam is actuated by gearing from the main shaft through the shaft  $\underline{W}$ .

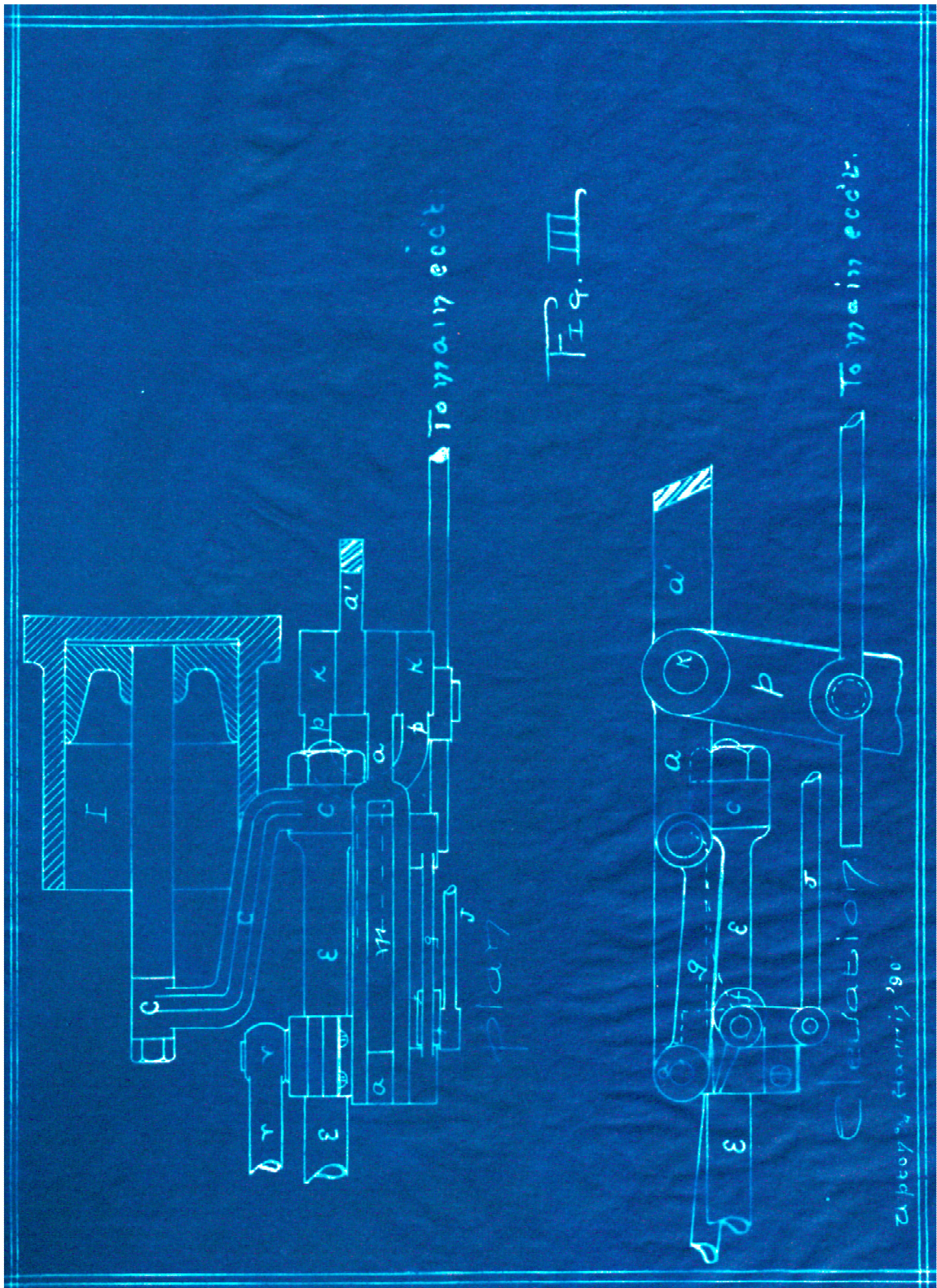
In the forgoing discussion of the valve gearing we have endeavored to prove and believe we have proved what we claimed at the outstart.



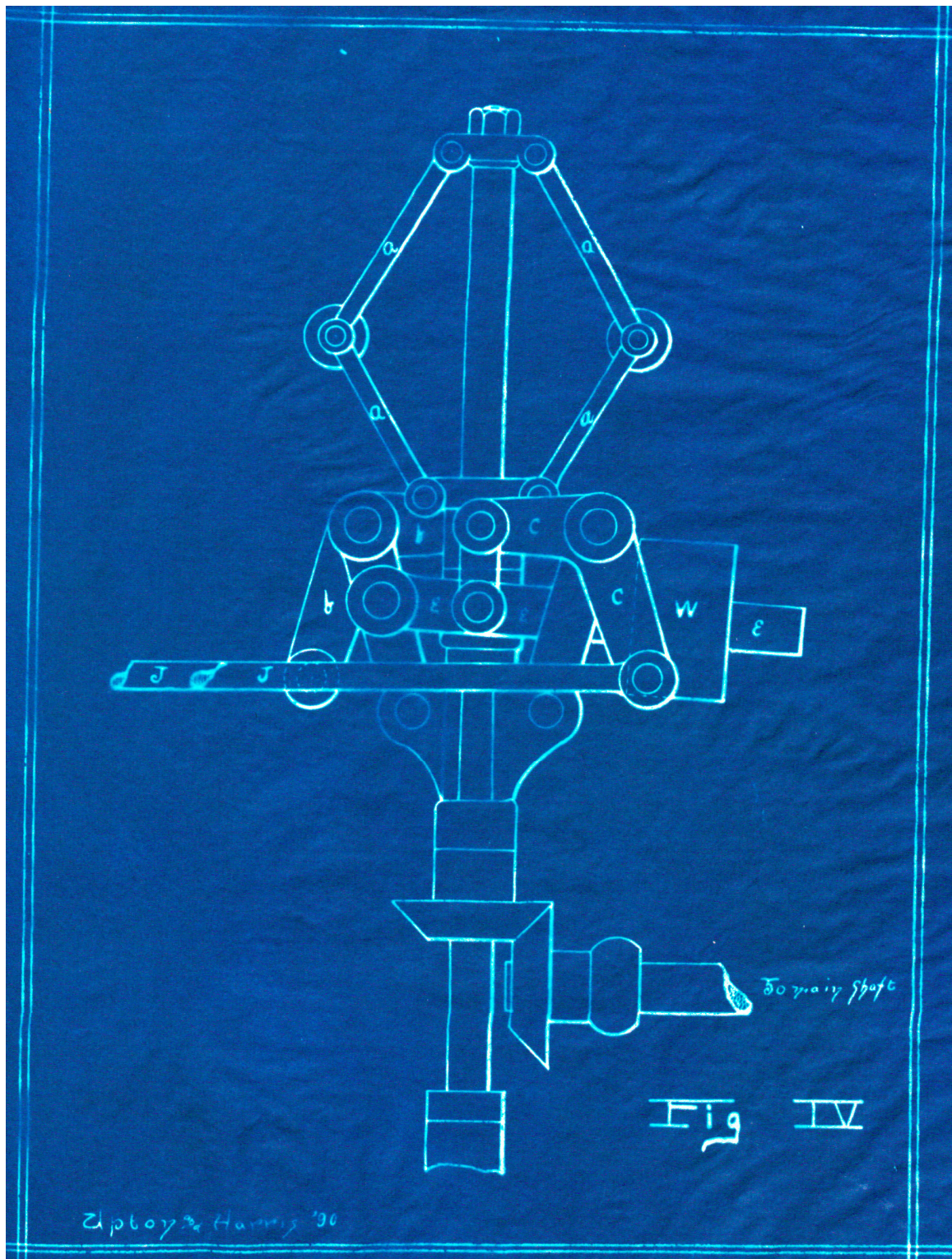




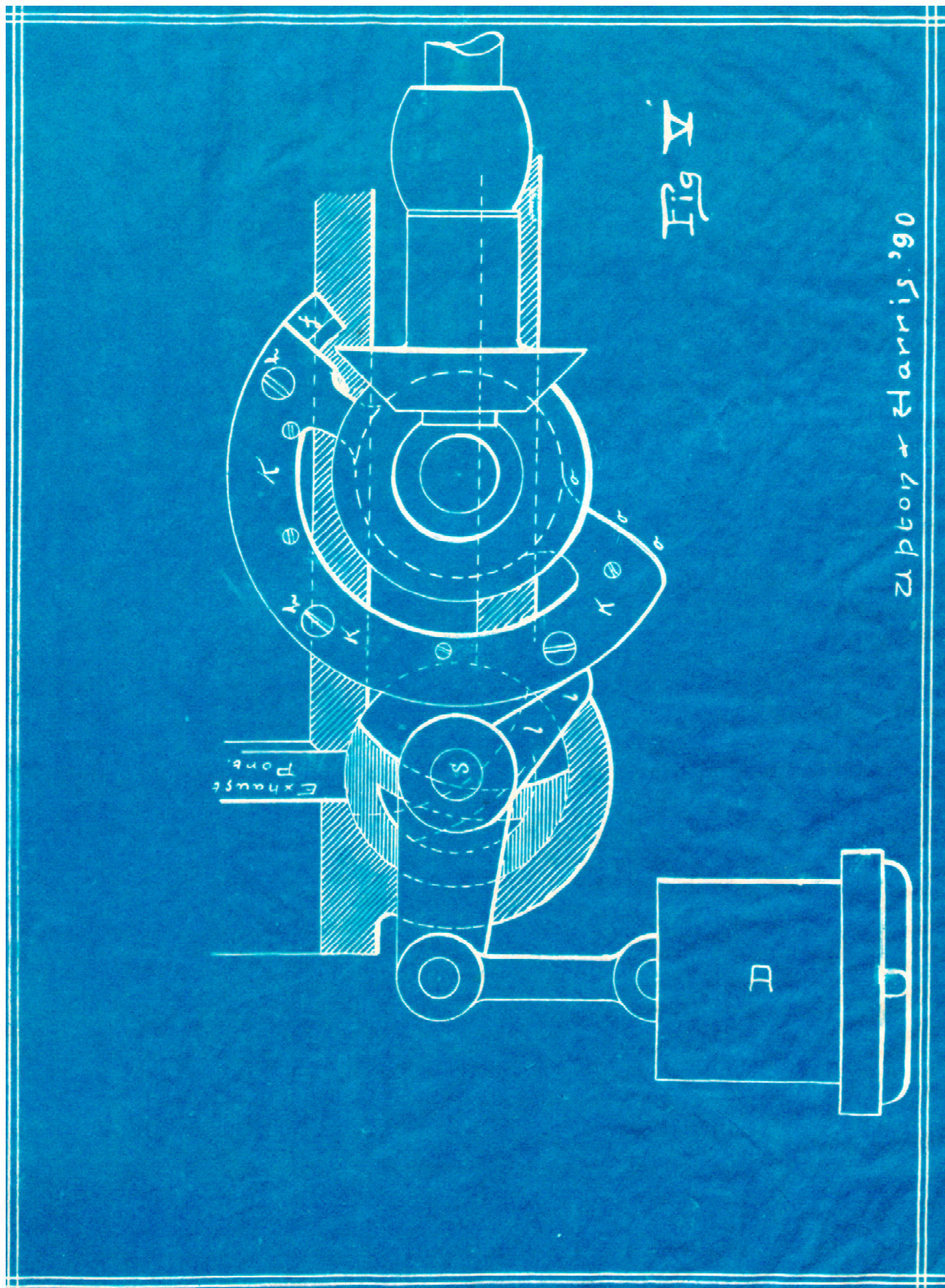




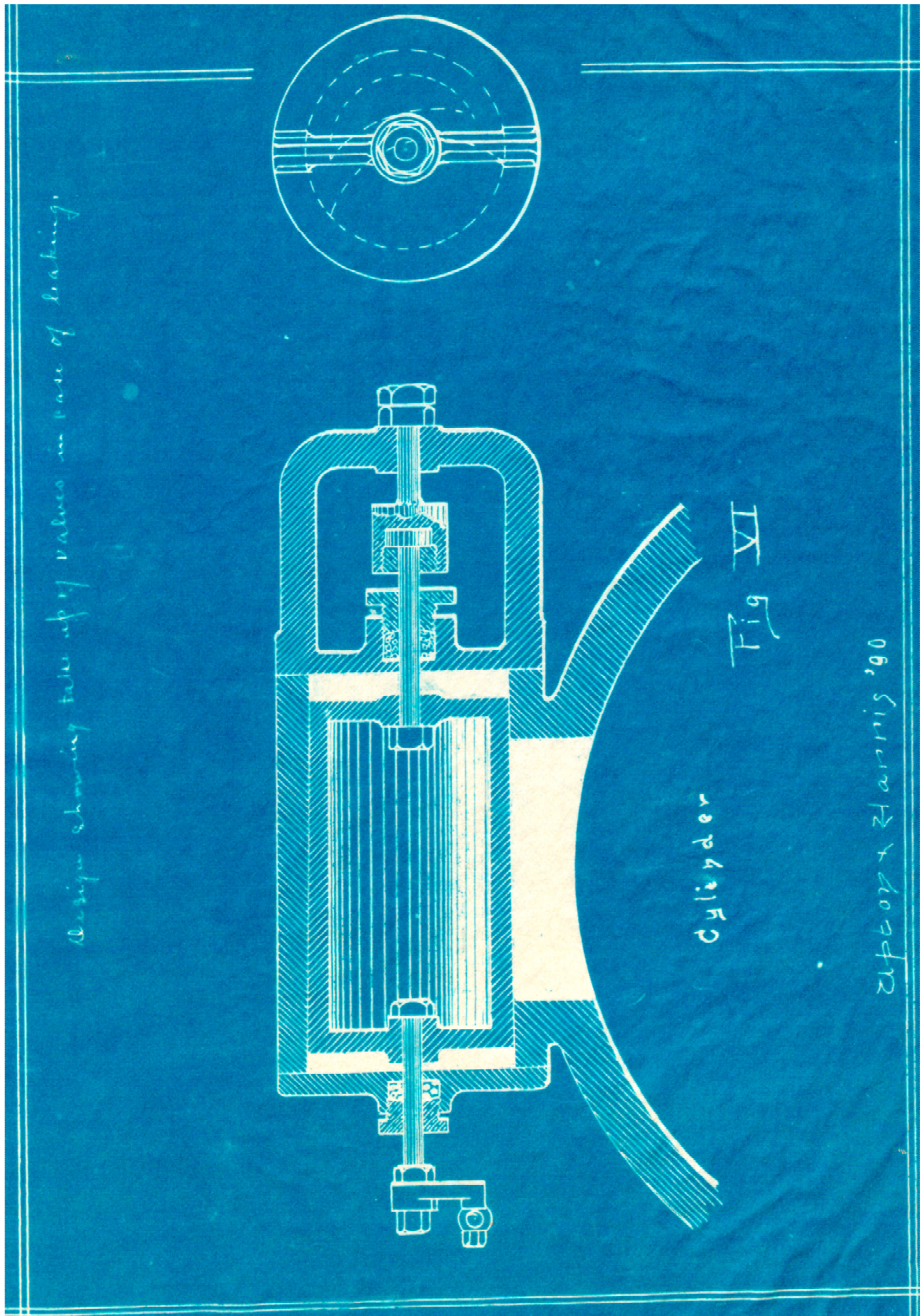




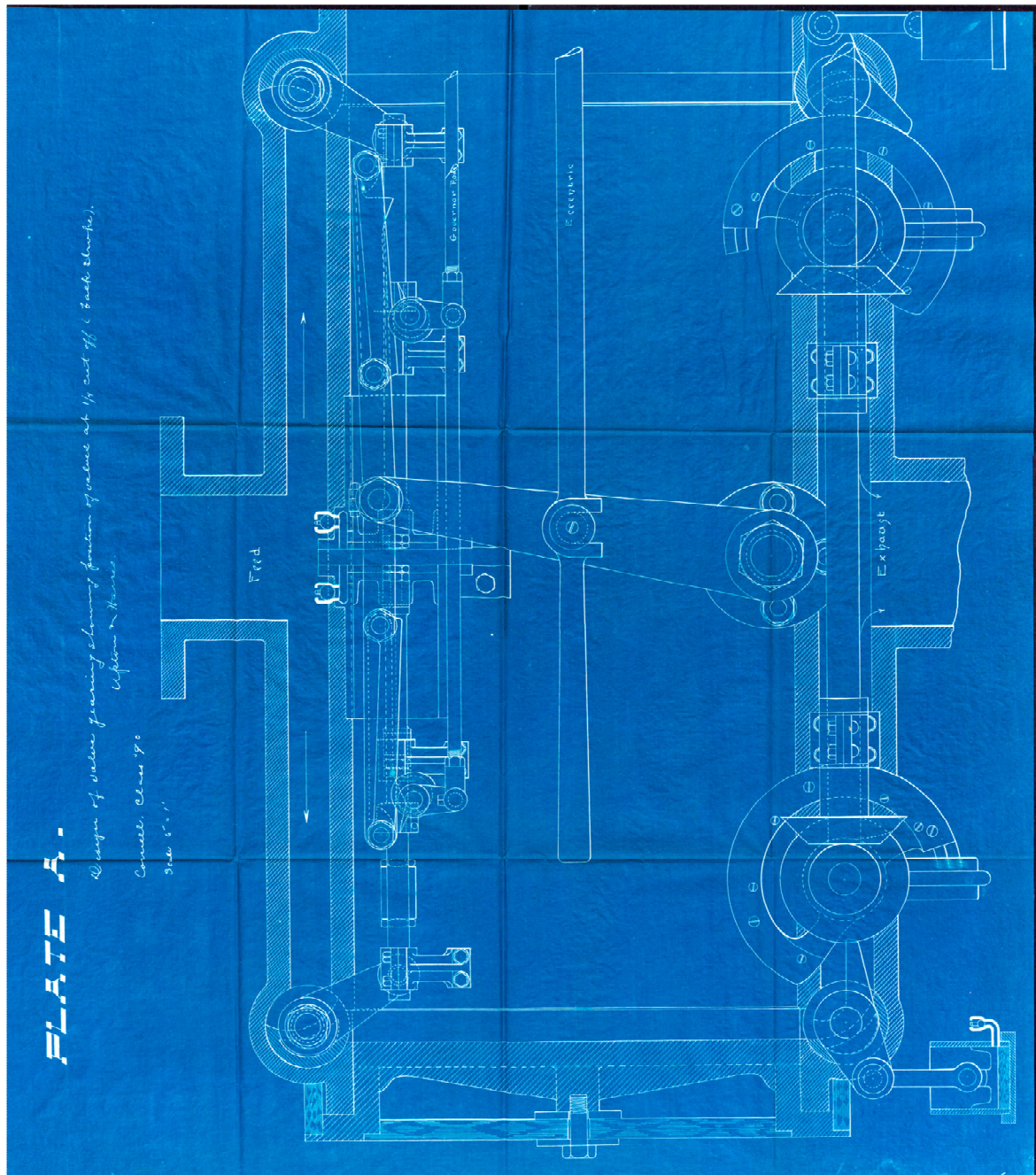




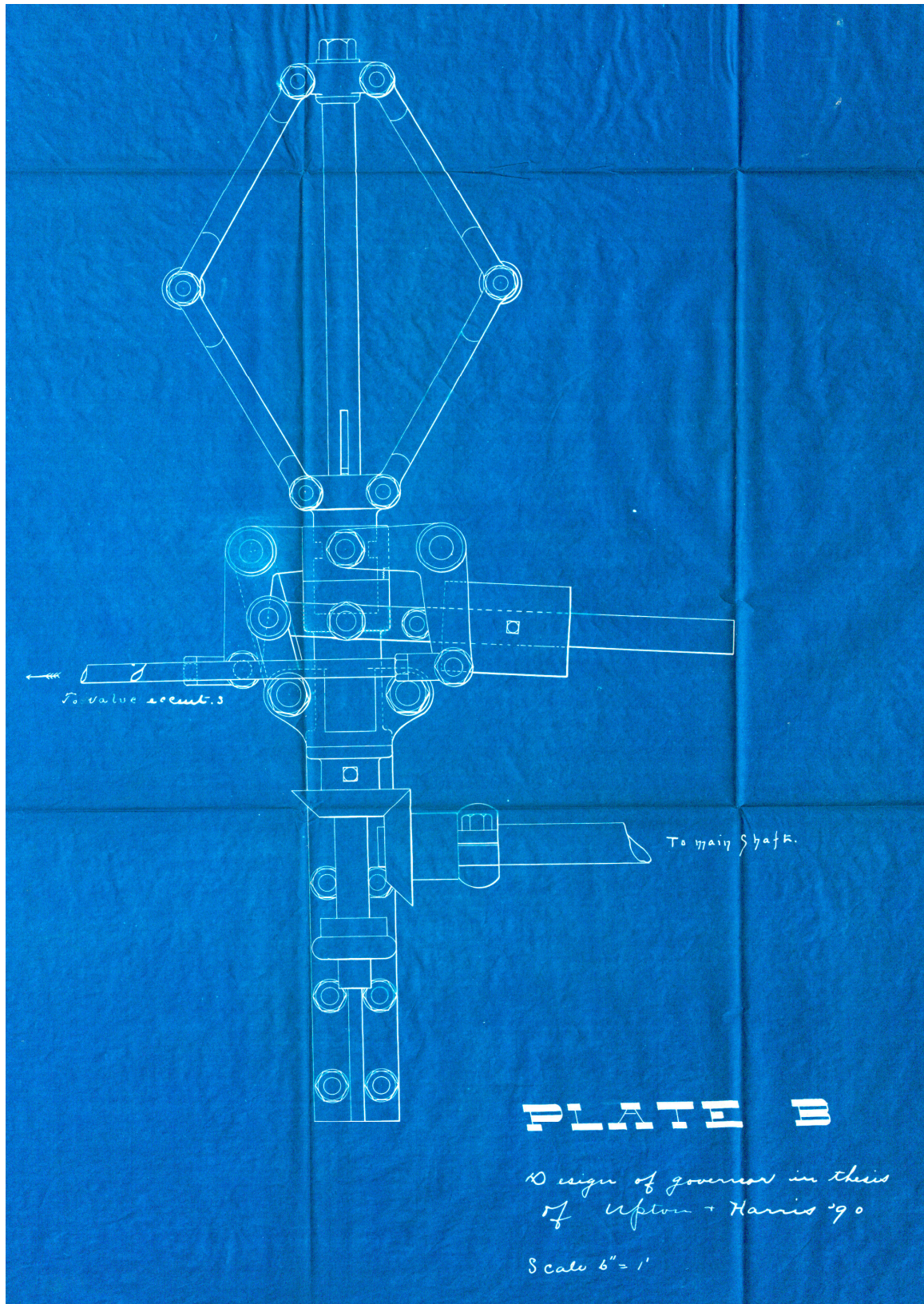




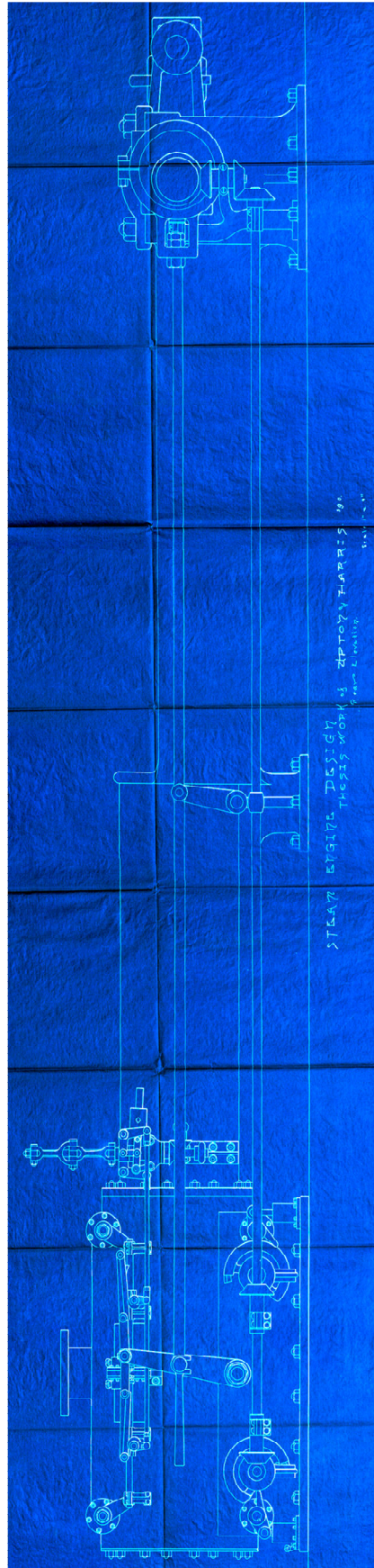












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